**Development of a jeans sizing system for young Black pear-shaped South African women**

By

Phumza Ntombovuyo Sokhetye

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Supervisor: Professor W. Yu (The Hong Kong Polytechnic University)

Signed: _____ Date: _____

Co-Supervisor: Mrs F. Kadwa (Durban University of Technology)

Signed: _____ Date: _____

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**ABSTRACT**

The South African pear-shaped Black women's jeans market has been confronted by fit dissatisfaction, although there is a growing demand for jeans. This study was approached from a viewpoint that jeans do not fit a large population of this consumer group and investigates the issues related to this problem. Local manufacturers and retailers currently use an adaptation of the British sizing system to suit their customer profile. Not much research however, has been carried out on developing a sizing system for the pear-shaped figure type, which makes up a sizeable portion of the population in the country. The intention of the study was to establish key variables for developing a jeans sizing system for Black South African pear-shaped indigenous women. A total of 60 Black women aged 18-35 years at the Cape Peninsula University of Technology were scanned for body measurements using a 3D body scanner. Body measurement differences were examined by using a quantitative research approach to establish the difference between waist and hip measurements. The findings revealed an average drop value of 39cm between waist and hip circumference for a Black pear-shaped figure, in comparison to a drop value of 24cm for a standardised sizing used by the clothing industry. It is recommended that the major stakeholders in South Africa conduct a national anthropometric study to update sizing systems, by using 3D body scanning technology, which provides accurate and consistent measurements of the human body.

**DECLARATION**

I, Phumza Ntombovuyo Sokhetye, hereby declare that this dissertation that I submit for a Master of Technology in Fashion at the Durban University of Technology is my original work and has not previously been submitted by me for a degree at this or any other University.

Phumza Ntombovuyo Sokhetye

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Student Number: 16202820

December 2016

**To the late**

**Julius Magobheni Sokhetye**

**1943-2004**

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Tata, I dedicate this work to you.

You valued education and taught me about determination.

You are dearly missed.

---

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*"I can do all things through Christ who strengthens me."*

(Philippians 4:13)

## TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

# CHAPTER 1

# INTRODUCTION AND MOTIVATION

## 1.1 Introduction

Jeans shopping in South Africa is increasingly becoming an important part of the entertainment for Black women consumers. Anecdotal evidence revealed that retailers received a huge volume of customers for jeans despite being confronted with a generally constant need to improve the jeans sizing system, due to Black women customers' dissatisfaction with jeans sizing and fit. The general clothing shopping trend and customer dissatisfaction with sizing and fit is well documented in South Africa (Strydom and De Klerk 2006). Alexander, Connell and Presley (2005:52) assert that fit in a garment remains an important factor that contributes to the confidence and comfort of the wearer. South Africa's diverse population currently purchases clothing that is made from overseas sizing systems and adjusted to suit South African diverse body shapes, yet the majority of people's body proportions deviate from standard sizes (Alexander, Connell and Presley 2005:56). It is imperative for countries, to establish their own sizing systems based on the needs of a specific target market.

The Council for Scientific and Industrial Research (CSIR) and the Department of Trade and Industry (DTI) had discussions in 2012 with local retailers, namely Edcon, Woolworths, Ackermans, Pep Clothing, Pick n Pay, Foschini, Exact and Truworths. They all highlighted the need for obtaining body measurement data through a National Sizing Survey for the South African population using a 3D body scanner. It was intended that the survey would result in the development of a South African garment sizing system in order to manufacture better fitting garments (Industrial Development Corporation of South Africa Limited 2011:8). This could not happen due to insufficient funds to run the project.

To be competitive, the South African clothing industries need to supply garments that meet customer needs. In 2014, one of South Africa's leading retailers in Cape Town

embarked on a national sizing survey using a 3D body scanner to ensure that clothing sizing standards are achieved to meet customer demands. The sizing survey was conducted in Durban, Cape Town and Johannesburg.

Retailers and manufacturers in South Africa are losing a sizeable volume of sales due to ill-fitting garments and individuals end up spending their money on alterations. The Industrial Development Corporation of South Africa Limited (2011:8-9) mentions that the population has become more diverse in shape, due to lifestyle and socio-economic changes. The need to update sizing is crucial. South Africa is divided into various racial groups of Whites, Blacks/Africans, Indians and Chinese, with Blacks constituting the majority of the population. Scholarly literature has recorded that Black people are more likely to complain about garment sizing and fit (Mastamet-Mason, De Klerk and Ashdown 2012:106; Strydom and De Klerk 2010:75; and Strydom and De Klerk 2006:80).

Clothing in South Africa, particularly jeans, has been embraced by most racial groups, due to their versatility, and the fact that they can be worn from offices to gardens to construction sites of roads and buildings. Most Black people have experienced major challenges in finding a well-fitting pair of jeans due to retailers' prioritising the market of the past and lack of recent, updated and inclusive data on jeans sizing and fit (Coetzee 2010). A body measurement chart of the Black consumer group has not been developed in South Africa. Manufacturers and retailers have adjusted measurement charts to suit their different consumers. Each manufacturer or retailer in South Africa decides on what specific sizing system to follow due to non-standardisation of garment sizing. This creates confusion and dissatisfaction among consumers when they have to select garments in stores. For example, a size 12 pair of jeans from one store may differ completely from a size 12 in another.

Anecdotal evidence suggests that, prior to 1994; few Black women could afford to buy the branded denim jeans from South African leading retail outlets, such as Foschini, Edgars, Truworths, Woolworths and Stuttafords. Black women could only

afford to buy from these retailers in the post-apartheid after 1994, when the democratic government initiated reforms to ensure that all individuals had an equal chance of being selected for employment and being treated equally once hired. Special emphasis was given to disadvantaged groups, which included Blacks, Coloureds, Asians, the disabled and women who experienced discrimination in past decades (Grobler, Warrich, Carrell, Elbert and Hatfield 2006:82). In the post-1994 era, Black women began focusing on the process of developing themselves economically as a means to live a liberated and modern lifestyle. This was evident in the analysis of South Africa's first nationally representative household income and living standards survey, which indicated that half of all Black South Africans lived in poverty in 1993 (Carter and May 2001:1987).

The post-apartheid South Africa has spawned an extensive impact in the lives of the upwardly mobile Blacks. Thomas White International (2011:4) documented the first signs of Black Africans making their presence felt in the middle-income group. The survey data showed that around 300 000 South African Blacks had risen to the middle-income status over the period 2001-2004. Grobler *et al.* (2006:71) mention that the influx of women into the labour force, together with the legal, political, social and economic efforts to advance gender equality in the workplace, would in future, undoubtedly lead to increasing numbers of women occupying leadership positions.

Thomas White International (2011:4) indicates that higher disposable income in the hands of the economically advancing Black professionals resulted in habits of indulging in spending sprees. There was an increasing demand for motor vehicles, furniture, media, clothing, property and cell phones among the Black middle class. This shift was a turning point, which saw changes in lifestyle, including enhanced dressing standards. Black middle class women became more particular with the way they looked in their daily lives. Fashion and ideal body shape became more important to them, culminating in substantial budgets being invested on clothes to maintain the 'good look' and presentation of self. The influential Western image, in so far as dressing is concerned, shaped Black women's mind-sets to focus on certain aspects of clothing, such as jeans. Coetzee (2010), in an interview, states

that branded denim jeans became the most important item of their clothing to complement their lifestyle.

### 1.2 Background and Significance of the study

South Africa's world of fashion has become competitive and challenging to Black females who are now occupying well-paying positions in the corporate world. These women have started to pay particular attention to their appearance in general and dressing up beautifully has become one of their top priorities in everyday life, in order to portray a positive image about the way they look and do things.

Anderson, Brannon, Ulrich, Presley, Woronka, Grasso and Stevenson (2001), cited in Nkambule (2010:1), argue that the shapes and sizes of women have been changing over the past decade, while sizing standards and garment proportions used by apparel industries have not changed. Mastamet-Mason, De Klerk and Ashdown (2008:10) assert that female body shapes and proportions vary and change over time, as the result of amongst others, nutritional changes, lifestyles and ethnicity. Dissatisfaction with fit is one of the most frequently stated problems with garment purchases (Mastamet-Mason, De Klerk and Ashdown (2008). This has created problems in the clothing and textile sector as garments that are produced are not meeting customers' expectations.

Strydom and De Klerk (2010:75) indicate that, in many developed and developing countries, one of the challenges that the South African apparel industry still faces is that of providing well-fitting garments for the variety of human shapes and sizes. A need to revolutionise the clothing industry with regards to garment sizing has become urgent. Mastamet-Mason, De Klerk and Ashdown (2008:11) mention that most female sizing systems, currently in use, are based on the ideal Western figure that has well-proportioned body components. Although shapes have been classified in most developed countries to solve the problem of apparel fit, African shapes have, however, not been taken into consideration. As supporting evidence, Mastamet-Mason, De Klerk and Ashdown (2008:11) have cited Kenya as a classic case of the non-classification of body shapes in the African region.

A similar challenge is being experienced by the South African Black females, especially when they have to shop for pants and jeans. Hence, the focus of this study is about developing a jeans sizing system for Black South African indigenous women who have a smaller waist with a larger hip or butt measurement, fitting into the pear-shaped body category. McKinney (2007:35) argues that women are least satisfied with the fit of pants due to the unaddressed sizing-related issues. According to the researcher, jeans designs are typically not in harmony with most Black women's figure forms, and there are various issues that Black women face when looking to purchase a well-fitting pair of jeans. Through observations and preliminary studies, most jeans available in retail outlets are either high waisted or have a low-rise with a slight difference in measurement between the hip and waist. This is problematic for most indigenous Black females as there is often a marked difference between their hip and waist measurements; the norm being a narrow waist with a wider hip. Strydom and De Klerk (2010:75) affirm that, in some cultures, mainly in Africa, the bottom-heavy body shape typifies a substantial percentage of Black African women.

This becomes a challenge for jeans block pattern development where the block pattern needs to represent a curvier shape. McKinney (2007:2) highlights the various problems with crotch fit such as being too tight, too short, too long or too loose. Apparently, current jeans production methods are not providing garments to satisfy the fit-needs of the majority of Black female consumers. To improve jeans fit of a female, Mastamet-Mason, De Klerk and Ashdown (2008:10) advise that, through body scanning technology, body dimensions and shapes are easily and rapidly extracted from a population and converted immediately into body shape categories, size charts and patterns for garment production. Body scanners are a relatively recent technology whose main function is to measure the surface topography of the human body, producing a 3D image of the individual being scanned as well as an extensive list of body measurements (Heuberger, Kinnicutt and Domina 2012:1486). The [TC]2 NX12 3D body scanner operates as a fully automated system that scans the entire body in six seconds, generating approximately 100 to 176 body landmark measurement points (Pandarum 2009:41). Currently, the 3D body scanning is

increasingly being used by retailers and manufacturers to measure their customers and provide made-to-measure apparel (Pandarum 2009:38). However, the potential of this technology is yet to be fully unleashed and appreciated.

This technology came into practice in 2000 in the United States of America (USA), when Lands End sponsored the 'My Virtual Model Tour 2000' as the world's first body scanning truck (Simmons, Istook and Devarajan 2004:5). SizeUSA, a collection of 3D body measurement data of over 10 000 men and women in the US, was completed in the fall of 2003. SizeMexico was planned for late 2004 and SizeCanada was in its developmental stage at the time (Simmons, Istook and Devarajan 2004:5).

Strydom and De Klerk (2006:82) point out that the use of a three-dimensional body scanner could make body measurement surveys more accessible to the clothing industry. The authors mention that very little is known about how the South African clothing industry functions with regard to problems experienced with body measurements. Strydom and De Klerk (2006:82) assert that scanning technology has the potential to enable researchers to collect and process more accurate anthropometric data, almost instantaneously.

The visible difference between means of scanned data and standard values in the currently used sizing charts highlighted the long overdue need to update the sizing charts using a national anthropometric database generated locally (Zwane, Sithole and Hunter 2010:265). Currently, the South African researchers and retailers are exploring rolling out a large-scale sizing project using body scanner technology (CPUT news/viewer, n.d). The newsletter cites Pandarum, who has conducted research using the body scanner, saying it is absolutely vital because of different body shapes.

Strydom and De Klerk (2006:80), writing within a South African context, view the ultimate success of any sizing system to lie with the accuracy of body measurements taken, since problems with fit often originate from out-dated and inaccurate body measurement data. Strydom and De Klerk (2006:80-81) state that size charts in use provided out-dated size specifications, which still remain the basis for pattern

development in South Africa. To revise the current sizing systems used by the South African Clothing industry, it is necessary first to obtain current measurements of the representative population for which the sizing system is targeted. The purpose of the sizing system for apparel should be to make clothing available in a range of sizes that fits as many people as possible (Simmons, Istook and Devarajan 2004:3). It has been noted that incorrect sizing is the number one reason for returns from retailers (Anderson *et al.* 2001:2).

Dimensions from the human body underpin an effective sizing system and consequently, better-fitting apparel items (Mastamet-Mason, De Klerk and Ashdown 2008:10). Since the body shape is three-dimensional, the measurements obtained from it must be accurately taken and be representative of the critical physical characteristics for well-fitting apparel. This will facilitate the production of apparel items, which will harmonise with the body shape.

There is an urgent need to determine fit problems with jeans for indigenous Black women in South Africa, with the objective of attaining consumer satisfaction. Coetzee (2010), in an interview, states two critical problems for the large retail outlet where she is employed. Firstly, the outlet has a standard body measurement chart that caters mainly for a White female body shape; and secondly, there is currently no data available on the average indigenous Black female shape, in spite of the fact that the average consumer profile is changing to indigenous Black people.

Strydom and De Klerk (2010:75) argue that the Black affluent group of middle class South Africans has grown in numbers from 2 million in 2005 to 3 million in 2010, and that their collective spending power has risen from R103 billion to R237 billion in 2010. According to Strydom and De Klerk (2010:75), there is a direct relationship between an increase in income and a shift in social class. This could indicate a shift in consumption patterns and lifestyle changes, which are already evident in the Black middle class emphasis on purchasing luxury and branded goods, especially clothing.

In addition, the emergence of a democratic government in 1994 influenced people's perceptions of how an indigenous Black woman should dress. The rainbow nation brought about the openness in the sharing of cultures, which has had an impact on the creation of a cosmopolitan woman. Waldron (2000) takes Roger Scrutom's meaning of 'cosmopolitan' a step further, as the belief in and pursuit of a style of life which shows acquaintance with and an ability to incorporate the manners, habits, languages and social customs of cities throughout the world. The researcher assumes that, with city lifestyle, clear cultural distinction no longer dominates when compared to the past, where, for example, indigenous Black women were not completely free to wear pants. The researcher thus sees a need to revolutionise the sizing system for Black women because this group is now moving towards a cosmopolitan lifestyle, necessitating a better fitting jean.

South Africa is committed to gender equality in the workplace and, as such, there is an increasing female participation in the workforce where jeans are acceptable as a dress code. For example, on a Friday, some banks allow the use of jeans as part of their uniform.

The socio-cultural manifestations in South Africa in the post-1994 era have led to vast changes in the market place, and retail outlets are now consistently receiving an increased volume of Black South African indigenous women customers. Van Der Berg, Louw and Yu (2008:74) assert that, between 1993 and 2004, the rapidly growing Black middle class is a natural consequence of advancement in the living conditions of the Black people at the lower end of the income distribution. Black middle and upper classes are growing, and this rise is driven by escalating Black purchasing power.

### 1.3 Problem statement

The quality of clothing and personal image is becoming an important feature to the economically advancing Black females as income distribution patterns change. The increase in demand for jeans by Black females has led to the realisation that no specification charts, taking cognisance of fit and their body shapes have been

developed to cater for this segment of the population. Instead, an adapted version of the British sizing system is being used to develop block patterns and garments, which explains the problem of ill-fitting jeans and clothing for Black women. This study is, therefore, aimed at investigating the ways in which these challenges can be addressed, using 3D body scanning technology.

### 1.4 Aim

The aim of this study is to develop a jeans sizing system to fit the hip and waist of the Black pear-shaped indigenous women in South Africa.

### 1.5 Objectives

The objectives of this study are:

- To obtain accurate lower body measurements of the Black South African pear-shaped indigenous women through the use of a 3D body scanner; and
- To develop a sizing system for producing well-fitting jeans for the Black South African pear-shaped women consumer.

### 1.6 Research questions

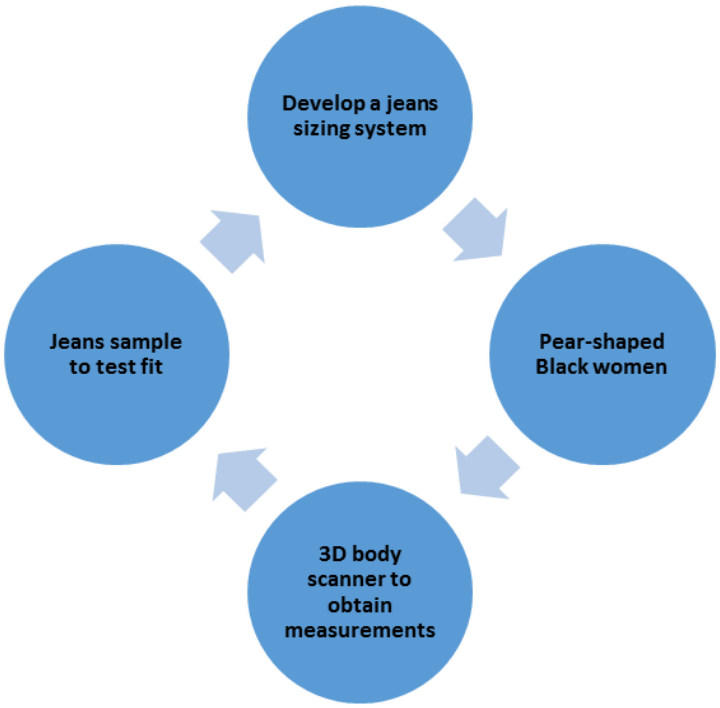
In developing a jeans sizing system which is suited to the body shapes of the Black South African indigenous women, the following specific research questions have been framed:

1. What are the experiences of Black South African pear-shaped women with regard to jeans fit and measurements, currently in stores in South Africa?
2. What are the key body measurements related to jeans fit for Black South African pear-shaped indigenous women?

### 1.7 Research process

A research process shown in Figure 1.1 based on anthropometry was adopted, as sizing systems are generally based on a selection of body dimensions from an anthropometric study of the population for which the sizing system is designed (Mastamet-Mason, De Klerk and Ashdown 2008:27).

Figure 1.1: Anthropometric research process




Source: Self-generated

## 1.8 Delimitations

This study was delimited to Black staff and students of the Cape Peninsula University of Technology, as the body scanner is housed in the Department of Clothing and Textile Technology at the Bellville campus. The nature of the research involves developing well-fitting jeans for Black women in South Africa.

## 1.9 Definition of terms

The following relevant terms are applicable to this study:

- Anthropometry: the scientific study of the measurements and proportions of the human body (Van Huyssteen 2006:5).
- Size chart: consists of all the body measurements taken from the selected population (Van Huyssteen 2006:8).
- Sizing system: a set of pre-determined body sizes designated in a standard manner (Van Huyssteen 2006:9).
- Black indigenous: Originating in, and characteristics of, a particular region or country. In the context of this study, it refers to the Black people of South

African origin (Thesaurus 2016).

- Pear-shape is a body shape that is much wider at the hip than at the upper torso (bust and shoulder) with an indented waist (Ola-Afolayan and Mastamet-Mason 2013:204).
- Drop value in the context of this study is the difference between the hip circumference and waist circumference.

## 1.10 Chapter overviews

Chapter 1: Introduction

This chapter presents a summary of the research. It includes the significance of the study, problem statement, research questions and the aim and objectives of the study.

Chapter 2: Literature review

This chapter focuses on the review of scholarly literature pertinent to the study.

Chapter 3: Research methodology

This chapter focusses on the quantitative research approach found to be most suitable for the study, sample selection procedure, data collection and analysis.

Chapter 4: Research findings and product analysis

This chapter elaborates on the quantitative findings of the study and a sizing system for the indigenous Black African pear-shaped body is developed. A block pattern is developed and used to construct a master pattern from which a jeans sample is made up to test for fit.

Chapter 5: Conclusions and recommendations

This chapter concludes and provides key insights emerging from the study.

## 1.11Conclusion

This chapter discussed the background to problems encountered by Indigenous Black women in South Africa. The next chapter focuses on the literature review of this study.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

Jeans are referred to as a type of 'world dress' that has been culturally embraced or authenticated by people from all over the world. Over the past two decades, jeans have been the one fashion constant that crosses over ages, sexes, cultures and countries (Wu and Delong 2006:238-239). Hegarty (2012) confirms that it is difficult to find a garment as widely embraced, worn and loved the world over as jeans. The classic jeans symbol of the American West is now a staple in wardrobes around the world. Many fashion designers of 'fast fashion' clothing companies are now making jeans a fashion necessity. Fashion designers have even made denim tuxedoes for the most formal occasions. Jeans are popular today for the same reasons they were popular when Levis Strauss first made them in the 1800s (Austin 2007:17). Denims or dungarees are what people now commonly refer to as jeans. Denim jeans have been embraced by different cultures across the world. Wu and Delong (2006:238-239) assert that the rapid growth in disposable income in China coupled with a large population desiring Western products, provides the world's largest potential consumer market for jeans companies. Similarly, there is a growing market for jeans in South Africa.

Since jeans were formerly developed as a man's garment, there were bound to be problems when styling for women, especially in pattern drafting and fitting, because women have differently shaped and curved bodies whilst male body shapes are mostly straight (Hlela 2010:4). Therefore, designing denim jeans for females requires careful investigations, including correct body shape and measurement size charts. According to Rahman (2011:7), it is evident that the fit of denim jeans plays a critical role in the success or failure of a product.

The diversity of sizes in South Africa, due to the different racial groups with varying body shapes, makes it difficult for the clothing industry to cater for well-fitting jeans.

When Levis Strauss (the popular American jeans company) conducted a jeans study for the African American pear-shaped figure to solve problems with jeans fit, the company extended the survey to South Africa where similar problems are encountered (Shin and Istook 2007). In 2012, Levi Strauss launched 'supreme curve' jeans in the US market, acknowledging that there was a significant percentage of curvier women in the US who wanted a great fit for their body shape (Faust and Carrier 2014:11). Although a similar situation exists in South Africa, the South African pear-shape is different from the African American pear-shape and as a result, there is still a problem experienced with a good jeans fit.

The Black South African pear-shape body is very narrow at the waist line and broader at the hip line with more prominent buttocks (Strydom and De Klerk 2010). The historical Khoisan woman, Saartjie Baartman, is considered an exaggerated representation of the South African pear-shape body (Mastamet-Mason 2014:114). The majority of Black females in South Africa are generally considered to have the Saartjie Baartman's pear-shaped body (Mastamet-Mason 2014:114). In most African cultures, a curvier body shape might be promoted as an ideal. Mastamet-Mason (2014:113) emphasises that in most African countries, thin women are not considered attractive. Until the 21$^{st}$ century in Africa, full-figured women were considered attractive, were respected, and their padded and curvaceous bodies represented wealth, fertility and good health (2014:113).

### 2.2 Body measurements

Anthropometric body measurements, which refer to the measurements of the human individual (Bertilsson, Högberg, Hanson and Wondmagegne 2011:1), have intensified worldwide because of the numerous garment fit problems experienced by the ready-to-wear industry.

For the purpose of this study, anthropometric measurements that are critical when constructing patterns for jeans are waist, abdomen, hips, outer leg seam length, in leg seam length, crotch length, width of the calf, and knee and thigh measurements. Alexander, Connell and Presley (2005:59) note that fit problems at the waist, hip,

thigh and pant length were more likely to be reported by the pear and hourglass body types, than the rectangular and inverted triangle body types. Strydom and De Klerk (2010:75) propose that, in order to ensure well-fitting garments and good fit in general, it is of utmost importance that manufacturers and retailers have a sound knowledge on exactly how and where on the body the various measurements need to be taken; and to use equipment that will enable them to take consistently accurate measurements. Apeagyei (2010:59) states that a 3D body scanner is used to extract scientifically, body measurements in a valid and reliable manner. In support, Kennedy (2008:19) states that the 3D body scanner provides a powerful and flexible tool in defining measurements for pattern construction, body measurements and shape identification.

Otieno and Fairhurst (2009:143) point out that one fundamental concern about clothes has been 'how to assess the size and proportion of the human body in order to assign the garment size'. Similarly, Strydom and De Klerk (2006:81) assert that body measurements be considered together with proportions to enable a decent fit for different people. Otieno and Fairhurst (2009:144) report that body measurement tables are used for developing clothing size charts. Size charts consist of garment measurements that include ease allowances, used for making sample garments and for using as reference during fitting trials (Smit 2007:18-19).

Apeagyei (2010:58-59) has recognised that, prior to UK's national sizing survey in 2001-2002 in which 3D body scanners were employed, body measurement data dating as far back as 1950, were being used in pattern development and sizing for clothing. Female body shapes and proportions vary and change over time and between populations as a result of, amongst other things, nutritional changes, lifestyles, ethnicity, age, grooming and concepts of ideal beauty, such as breast enlargement which occur within different cultures (Mastamet-Mason, De Klerk and Ashdown 2008:1). Therefore, a sizing chart developed prior to 2000 will not be relevant for current use.

Strydom and De Klerk (2006:84) find that the South African clothing industry probably values, and strives for, accurate body measurements, which highlights the

need for undertaking a body measurement survey of the country's Black pear-shaped population. The results of the survey may help manufacturers and retailers with improving garment fit, minimising the risk of returns and also improving customer satisfaction.

### 2.3 Body types and jeans sizing charts

Body shape and proportions in a population are significant factors when considering clothing fit. The demand for manufacturing clothing that considers the traits of various body types is increasing considerably. Body types differ between races; body sizes, shapes and proportions of each are different. The female body shape of Black South African women resembles that of Saartjie Baartman, whose body shape was displayed on a London stage for public show between 1810 and 1811, and in 1815 she was further displayed, against her will, for 10 hours a day in Paris (Mastamet-Mason 2014:114).

Fig 2.1 A picture of Saartjie Baartman

Source: Yaneza (2016)

Adu-Boakye, Power, Wallace and Chen (2012:3) note that research has established that body shapes of women may differ from one geographical location to another due to different lifestyles, diets, socio-cultural values and ethnic composition of

populations. Therefore, a study on particular body types, in order to develop a size chart, representing the population is needed.

According to Faust and Carrier (2014:235-237), there are three basic human body types: endomorph, ectomorph and mesomorph. Ectomorphs are slim and tall with narrow hips and pelvis, long arm and long legs. Mesomorphs are strong with highly developed bones and muscles. Endomorphs are usually curvy and have a high tendency to store body fat. Female endomorphs usually collect fat in their buttocks, legs and hips. The Black South African pear-shaped body falls within the endomorphic figure type. Faust and Carrier (2014:237) advise that attention to specific markets has increased over the last few decades in the clothing industry, owing to the lack of well-fitting garments.

Van Huyssteen (2006:17) argues that size charts need to be developed according to the end use and the requirements of the specific target market. Size ranges available in stores usually concentrate on the smaller shapes and sizes, ignoring the endomorphic figures. In 2013, South Africa had an obesity rate of 42% for women and it has the highest overweight and obesity rate in Sub Saharan Africa (News24.com 2015). Therefore, it is not practically sound to focus on smaller sizes only, ignoring bigger body size types. Body shapes must be taken into consideration when developing size charts. According to Tulin (2012:1), a new sizing and fitting chart for jeans should be based on the concept of shape, not size.

Faust and Carrier (2014: 9) assert that fit was so important in jeans, that the NPD Group, a large consumer research firm that operates in 20 countries, reported that the average women tried on 15 pairs of jeans before buying one. Levis recognised that body shapes varied widely, and that consumers wore jeans very differently, based on personal wearing preference (Levis Curve ID. 2011). Shin and Istook (2007:136) found that consumers are still not satisfied with their purchases even after they have tried on multiple pairs of jeans when trying to find an appropriate size and style. These fit problems are associated with the current sizing systems that

overlook the diverse ethnicity that encompasses the full range of variation in body shapes, existing in the population.

The garment production and retail industries have struggled with the challenge of providing well-fitting garments for the variety of the population since the Industrial Revolution and the first introduction of mass produced clothing (Strydom and De Klerk 2006:75). Tulin (2012:1) confirms that the existing jeans sizing systems, which may have addressed the market demand of the time for which they were developed, do not adequately address the challenges of the modern consumers and their wide variety of body shapes. According to Rahman (2011:10), a considerable number of respondents in a study conducted in Canada, indicated that finding a pair of denim jeans that fits well, could be problematic. Ola-Afolayan and Mastamet-Mason (2013:207) point out the frustrations encountered by women with a pear-shaped body in ready-to-wear retail stores, and the fact that they cannot find garments that fit their unique bodies, can be challenging. Ola-Afolayan and Mastamet-Mason (2013:208) recommend that making size charts specifically for African pear-shaped figures may assist in formulating pattern blocks that could facilitate well-fitting garments for this body type.

In a country such as South Africa, providing specifically made apparel for indigenous groups with unique body characteristics has not been achieved even into the 21$^{st}$ century (Ola-Afolayan and Mastamet-Mason 2013:204). Vithanage, Jayawardana and Niles (2012:30) propose that mass production in the garment industry requires pre-defined size charts based on up-to-date anthropometric data. These standard size charts provide information for manufacturers and retailers to plan production and inventories. There is a plethora of evidence suggesting that no standard sizing charts can always be appropriate for producing ready-to-wear clothing across countries, as body shapes and sizes vary widely, unless a size chart is developed for a specific body shape (Ola-Afolayan and Mastamet-Mason 2013:204; Mastamet-Mason, De Klerk and Ashdown 2008:10). Therefore, every country within a specific racial group should have their own sizing systems based on the target population, to provide better fit for ready-to-wear clothing, which improves customer satisfaction

(Mastamet-Mason, De Klerk and Ashdown 2008:10). Shin and Istook (2007:136), writing within the American context, state that the demands for well-fitting jeans cause many clothing industries to manufacture customised jeans.

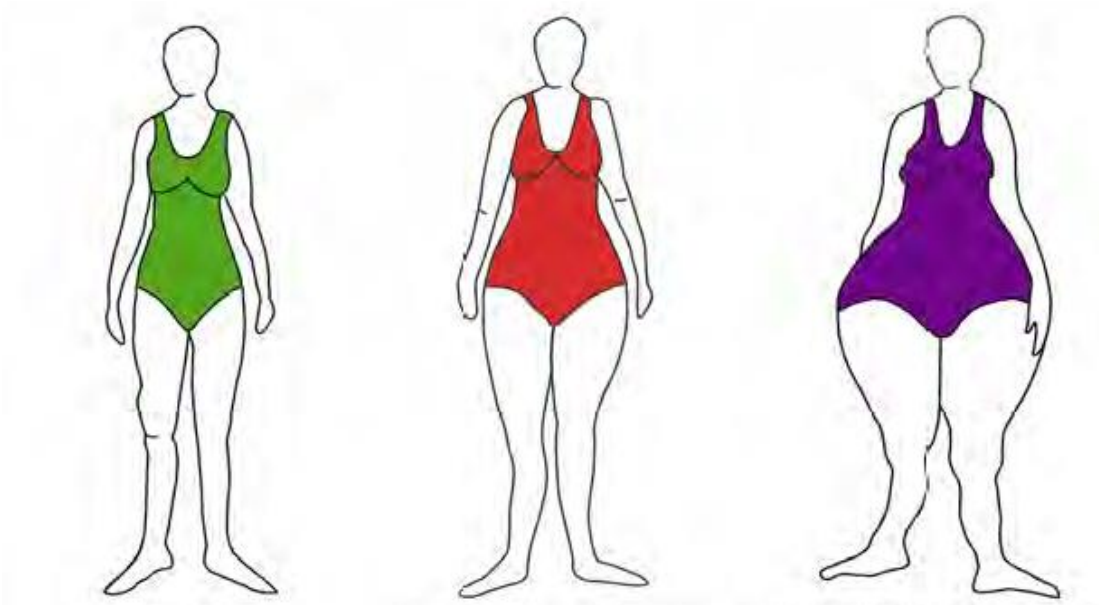
Since the body shape is three-dimensional, the body measurements obtained from it must be accurately taken and be representative of the body's characteristics that are critical to the fit of the apparel (Mastamet-Mason, De Klerk and Ashdown 2008:9). It is critical to find the characteristics of each body type among races, or countries (Lee, Istook, Nam and Park 2007:374).

The major factor that has an influence on the fit and satisfaction with clothing is body type and obesity. In most African countries including South Africa, there is an issue of obesity and this is becoming a global phenomenon (News24.com 2015). Obesity is a major public health problem among Black women living in urban South Africa (Puoane, Fourie, Shapiro and Rosling 2005:6). Similarly, Popkin, Adair and Ng (2012:3) mention that rapid increases in the rates of obesity and being overweight are widely documented, from urban and rural areas, in the poorest countries of Sub-Saharan Africa and South Asia to populations in countries with higher-income levels.

Finding a well-fitting pair of jeans for the body shape of Black pear-shaped women in South Africa is a challenge due to contemporary apparel sizing that is inadequate (Muthambi, De Klerk and Mastamet-Mason 2015). European sizing systems are adapted and used to produce garments for a Black South African pear body shape Strydom and De Klerk (2010:76). Even though there are adaptations in body measurements charts, the correct fit has not yet been achieved (Muthambi, De Klerk and Mastamet-Mason 2015). A study conducted in South Africa by Strydom and De Klerk (2010:80), states that the South African clothing retailers admit to having problems with fit and body measurements with most of their Black customers. It implies that the Black South African pear-shaped consumers are interested in having accurately fitting garments, which highlights the need for a body measurement survey of the South African population (Muthambi, De Klerk and Mastamet-Mason 2015:63). Ola-Afolayan and Mastamet-Mason (2013:203) state that 59.26% of South

African female students of African descent have a pear-shaped body and are forced to purchase loosely fitting ready-to-wear garments, but have to incur the additional cost of adjusting the garment before being able to wear them. The authors (2013:204) assert that the South African pear-shaped body, unlike the western pear-shape, experiences fitment problems when purchasing a pair of jeans, which are based on standard measurements of a well-proportioned figure.

Figure 2.2 The Ideal, Western and South African pear-shaped figures



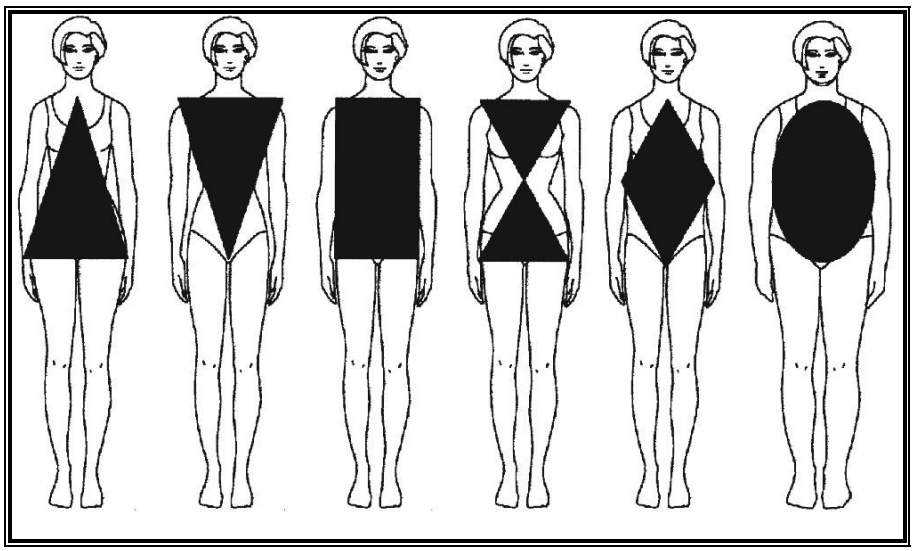
Ideal figure | Western pear-shape | South African pear-shape

Source: Ola-Afolayan and Mastamet-Mason (2013:205)

Figure 2.2 shows the difference between a western pear-shaped figure as opposed to a South African pear-shaped body. The South African pear-shape has specific needs and expectations from the retail outlets, that need proper investigation in relation to jeans sizes. Strydom and De Klerk (2010:75) mention that scientific garment cutting is based on measurements of the human form and therefore, the correct set of key measurements related to the specific product, is vitally important. Body shape in this regard is crucial for garment pattern making and cutting. Figure 2.3 displays different body shapes found in South Africa's diversified races, and

none of these body shapes is characteristic of a South African pear-shaped body, clearly indicating a need for size chart development for this specific body type.

Figure 2.3 Illustration of the different body types and shapes



Pear-shape Inverted triangle Rectangle Hourglass Diamond Rounded

Source: Mastamet-Mason 2009; Van Huyssteen 2006; Felton 2013

Images in Figure 2.3 depict the following shapes:

- *Pear:* The hips are slightly larger than the waistline;
- *Inverted triangle:* The bust circumference is larger than the hips;
- *Rectangle:* The bust and hip measurements are fairly equal. There is no clearly defined waistline;
- *Hourglass:* There is a small difference in the comparison of the bust and hip circumferences;
- *Diamond:* The stomach, waist and abdomen measurements are more than the bust. There are several large rolls of flesh in the midsection protruding away from the body; and
- *Rounded:* The average of the stomach, waist and abdomen measurements is less than the bust measurement (Mastamet-Mason 2009; Van Huyssteen 2006; and Felton 2013).

The political changes in South Africa over a decade ago resulted in a new emerging Black market with different body shapes and sizes (Van Huyssteen 2006:30). These changes signalled an important need to continuously update the sizing system. Van Huyssteen (2006:20) suggests that body measurement charts need to be revised at least every 10 years. Pisut and Connell (2007:369) report that with the continued emergence of diversity in age and ethnic groups, it is difficult to meet everyone's fit preferences with standard sizes. Van Huyssteen (2006:14) recommends that when creating a sizing chart, the population is first divided into different body types, based on dimensions, such as height. Van Huyssteen (2006:16) proposes that another important aspect of developing a sizing chart for use in the garment industry is the development of size charts for the specific market sector.

### 2.4 Ready to wear clothing

The South African clothing industries manufacture ready-to-wear garments that are mass-produced for different customers such as Foschini, Truworths, Edgars, Woolworths and so forth. Most South African retail customers still need to alter these garments before wearing them (Strydom and De Klerk 2010:75). Shin and Istook (2007:135) confirm that the ready-to-wear jeans market increased by 75% in 1998 and that was the largest growth in women's denim clothing in the United States of America. The authors stated that in 2005, American women between the ages of 35-54 years spent 31 billion US dollars to dress themselves in jeans, which was a 4.5% increase from the previous year. Although there is a high demand for jeans, jeans fit remains a huge challenge for the jeans market. Shin and Istook (2007:137) present that jeans global fit vs local fit is an important issue for a global business such as Levi Strauss that aims to benefit from economies of scale, stemming from worldwide advertising and standardised products. Strydom and De Klerk (2006:81) state that fit is determined by pattern making and pattern making starts with utilising accurate body measurements.

Agbo (2015: 32) confirms that in the Benue State of Nigeria, ready-to-wear garment producers and importers face challenges of producing or ordering the right sizes for

female users where the sizes, shapes or figures of the users in a particular locality are unknown.

It is therefore important to study carefully different body shapes for different countries in order to avoid garment returns and customer dissatisfaction. Al-Mousa (2011:688) establishes that, within the Saudi Arabian context, nowadays, customers are not satisfied with mass-produced offerings and are seeking unique identity clothing, which can be achieved by adopting mass customization. Al-Mousa (2011:688) suggests that apparel products need to satisfy not only each individual's taste, but also must fit an individual's unique body measurements. Therefore, in the Arab context, size and uniqueness of garment are essential for customer satisfaction.

Lee, Istook, Nam and Park (2012:104) state that lack of a standardised sizing system in the current clothing industry and lack of attention by industry 'to body shape changes during the aging process' could also contribute to garment fit problems. Dissatisfaction with fit of women's ready-to-wear is acknowledged in academic as well as in popular literature (Anderson, Brannon, Ulrich, Presley, Woronka, Grasso and Stevenson 2001:2). Agbo (2015:35) recommends that due to variations in size and shape of female adults, custom-made garments may achieve better fit than ready-to-wear garments, which may essentially require adjustments on purchase. A standardised garment size chart for ethnic groups to eliminate garment fit problems was also recommended by the industry (Van Huyssteen 2006:16).

### 2.5 Jeans dissatisfaction by Black South African women

Bickle, Kotsiopulos, Dallas and Eckman, (1995:208), writing within an American context, explain that the dissatisfaction with jeans fit has been well documented in popular press articles and contributing factors mentioned are outdated manufacturers' sizing system and numerical size codes. Whilst, Macdonald, Lazarchak and Currie (2009:261) confirm that sizing is an issue for many women; one woman in their study commented that they do not know their sizes because they can wear a certain size in one store and another size somewhere else.

An existing sizing system could be improved in many ways, one being the development of a new size chart that may have one to three sizes that are based on the target markets body and shape measurements, rather than on proportional fit assumptions (Loker, Ashdown and Schoenfelder 2005:2). Jeans, manufactured using standard size measurements adapted from overseas countries, do not suit the majority of South African pear-shaped women (Rzepka 2011:7, Coetzee 2010). Therefore, garments become 'ill-fitting' for the wearer who is very different in shape from measurements of a manufactured garment. For example, a person with a waist measurement that is much smaller and a hip measurement that is much larger with a prominent buttock, would not fit into a standard size pair of jeans that represents an ideal western body shape. Arthurs (2012) asserts that one of the common issues pear-shaped women face, is the gaping waistband; so many consumers say that the gape at the back waist is infuriating. Gaping in the back, usually exposes the area where one sees *'the cleavage of the rear-end'* or *'the rear-end crack'* as commonly referred to by university students in South Africa. Curvier women usually end up buying long blouses, shirts and t-shirts to cover the buttock area (Kamalia 2016).

The search for total satisfaction as a result of clothing fit problems has culminated into a number of anthropometric studies and surveys being conducted; to improve the accuracy of data obtained (Adu-Boakye *et al.* 2012:2). The importance of taking accurate body measurements can, therefore, no longer be ignored and the problem should urgently be addressed by the local clothing industry (Strydom and De Klerk 2006:88). A countrywide anthropometric study was conducted by Woolworths in February 2014 using the Alvanon 3D body scanner technology. Although the study was not specific to particular body shapes, different body shapes or types were scanned for measurements (Woolworths find your perfect fit 2014).

Rahman (2011:1) reveals that fit of jeans is the most important criterion for suitable jeans, followed by style and quality in Canada, whereas brand names and country of origin were relatively insignificant. Finding a pair of well-fitting jeans for most Black South African curvier women in retail stores continues to be a challenge for this

consumer group, unless consumers have garments custom constructed from scratch by a seamstress, tailor or their own hand (Rzepka 2011:7).

A good pair of jeans can be defined as a garment that has been constructed with good workmanship, fit and comfort to suit a particular body shape. Fit in a garment is one important factor that contributes to the confidence and comfort of the wearer. Dissatisfaction with fit is one of the most frequently stated problems with garment purchases (Alexander 2005:52-53).

Madikwa (2010) states that Levis launched a new range of jeans for the pear-shaped body that promised to fit every body type across the globe. Levis Curve ID (2011) mentions that 'Supreme Curve jeans' are designed to solve the fit problems of the curviest women, regardless of their small or large size. The Supreme Curve fit was initially available in select stores in South Africa. Based on preliminary reviews conducted, most South African pear-shaped consumers were dissatisfied with the Supreme Curve fit.

### 2.6 The 3D body scanner

The 3D body measurement system is designed to provide the user with accurate and consistent measurements of the human body rapidly, primarily for use in making better fitting garments (Body Measurement System Operating Manual n.d.:3). Pandarum, Yu and Hunter (2011:866) state that non-contact 3D body scanning is easy to use and has the ability to extract extensive anthropometric data in a very short time.

Song and Ashdown (2011:914) confirm that the 3D body scanning technology has shown the potential of providing anthropometric measurement data to improve the fit of clothing. Strydom and De Klerk (2010:76) state that key measurements from the scanner are used for creating sizing systems, drafting garment patterns, grading patterns, choosing fit models for fit testing and for communicating size designation of garments to the consumer. Therefore, the creation of a jeans size chart for a curvier

body shape will assist in developing jeans block patterns and grade rules to match the proportions of the target population.

Using the tape measure process to obtain measurements is embarrassing to the women being measured, because the person taking measurements unavoidably has to touch the subject; and it is difficult to maintain a standardised measuring procedure. The measurements are often unreliable, as the measuring tape can slide easily into the flesh (Pandarum, Yu and Hunter 2011:866). Simmons, Istook and Devarajan (2004:6) mention that the 3D body scan data is useful to identify different body types that can provide the clothing industry with tools to design for their target market.

It is, therefore, understandable why the 3D body scanner needs to be used in South Africa. In an e-mail correspondence dated 25 August 2011, Mr Tembo, the chief director of Clothing and Textiles at the Department of Trade and Industry (DTI), informed that a first pilot study on sizing, using the 3D body scanner, was to be conducted across South Africa in the near future. It did not happen due to limited funding by the government department. The 3D full body scanner is an efficient technology that is suitable for use in the clothing industry, given the additional measurements that can be incorporated when drafting basic blocks (Zwane, Sithole and Hunter 2010:270).

Coetzee (2010) asserts that one of the leading clothing retailers in Cape Town conducted fitting exercises to establish the average curvier body shape of a Black woman. After this exercise, they established which fit changes were required to make to their blocks or patterns to suit the curvier body shape of a Black woman. This was an attempt to forge new ways of developing a sizing system for this consumer group. According to Coetzee (2010), a stretch fabric is added to complement the design and size of the prototype jean. All these efforts proved that accommodating the curvier body shape of a Black woman in South Africa is not an easy process.

## 2.7 Capturing market share

These recurring problems are because sizing charts and systems used, were based on the European white female body shape (Strydom and De Klerk 2010:76). The other factor is that, during the apartheid era, few Black South African women could afford shopping in leading retail stores due to their low-income jobs, among other factors (Strydom and De Klerk 2010:75). The authors (2010:75) mention that it is only in the post-apartheid South Africa, where lives of many Black people improved owing to better career opportunities, which increased the demand for well-fitting jeans. Access to more disposable income has led to an influx of Black people shopping at leading clothing retail stores. Consequently, retailers are now keen on capturing the Black market share (Strydom and De Klerk 2010:75).

Retailers are facing a huge challenge as the sizing system does not accommodate this population group. Strydom and De Klerk (2006:82) view the development of three-dimensional body scanners as instrumental in opening up new possibilities for the measurement and analysis of the human body.

## 2.8 Women and Jeans

Archer (2008) states that the majority of Black South Africans have a high regard for traditional values and entrenched cultures. Spirituality, religious beliefs and social practises in South Africa were amongst the key factors, which shaped African women's dress code, and more often than not the Black women were not allowed to wear pants. All these beliefs have evolved from the legacy of male dominance, female oppression and culture, which were unfavourable towards African females. Within this context, Black women, such as the Zulus, Xhosas and Swazis, hardly wore pants in the olden days, as they followed their cultural practices (Archer 2008:389). Nowadays, the idea of not allowing women to wear jeans in the Black culture in South Africa is not easy to enforce, owing to the financial independence of many women and activism of gender groups and other human rights-based formations. Black women now have better incomes when compared to the past, and wardrobe planning becomes an important part of their daily lives. Western influences and a sense of freedom have come to play a significant role in clothing choices.

Jeans have turned out to be more popular than any other item of clothing in Black women's closets as confirmed by Hegarty (2012).

Archer (2008:390) reports that today's generation believes in doing what fits the individual, promoting a culture of personal lifestyle choices over collectivism. Jeans originated in the Western culture, but many African women adopted and embraced the trend. However, this trend is not peculiar to South Africa, given the documented evidence stating that denim jeans are now embraced by women all over the world (Kan, Yuen and Wong 2012:726; Hegarty 2012).

Most of today's Black women are living in the cities and have adopted dress culture of the city. Miller and Woodward (2007:337) confirm that, in the heartlands of the United States, the average American woman owns 8.3 pairs of jeans and over half of the adults in the UK usually wear jeans. Thus, jeans have become a timeless garment. Relative to the afore-mentioned, if 50 percent of the world's population is now probably wearing jeans; it obviously implies that the production and distribution of denim mobilises a huge work force around the world (Miller and Woodward 2011:182).

### 2.9 The ideal body shape within Black women

For the purpose of this study, the technical meaning of curvy women refers to a marked difference in the circumferences of waist and hip measurement, a very small waist with a much larger buttock. Plus-size women may not necessarily be curvy but are possibly rather round or oval as the body is covered with fat (Overstreet, Quinn and Agocha 2010). Standardisation of sizing becomes necessary when clothing manufacturers and chain stores are inconsistent in clothing size designation and sizing (Van Huyssteen 2006:29). It is, therefore, of great importance for curvier body shapes to have their own jeans size chart as this population group encounters major challenges with the size and fit of jeans, in South African retail outlets. Overstreet, Quinn and Agocha (2010:93) suggest that most Black men prefer women with a curvaceous lower body shape. In Black culture, a curvaceous lower body shape is largely celebrated and garners praise.

One idealised image that has garnered increasing attention in the body image literature is the curvaceous but thin body, which may be considered ideal. This ideal is often described as a woman with a medium bust size paired with a thin waist, 'curvaceously thin' (Harrison 2003:255-256). Overstreet, Quinn and Agocha (2010:92) declare that thinness is not the only standard of beauty that exists; researchers may be overlooking idealised images that can be the sources of body dissatisfaction. Mastamet-Mason (2009:56-57) reports that most studies define the ideal figure as a perfect human structure and a well-balanced shape which is usually used as a standard figure. An ideal figure is similar in width in the shoulders and hips, with a medium bust, small waist, flat to slightly curved abdomen, moderately curved buttocks and slim thighs (Mastamet-Mason 2009:56-57). An ideal figure is one that has no exaggeration on any part of the body. Body weight must be moderate. Molly and Herzberger (1998:631) mention that many women develop distorted body images and become frustrated at not being able to obtain the 'ideal figure'. Some women are dissatisfied with their body size and are driven to become thin and maintain that thinness.

### 2.10 Body shape of White women as opposed to Black women

Body type comparison between countries allows the opportunity to discover ways to improve the sizing systems of each country, as well as influence the development of international sizing standards that could have a significant impact on brands manufacturing products for a variety of international consumers who have different body sizes and shapes (Lee *et al.* 2007:374).

Overstreet, Quinn and Agocha (2010:93) assert that Black and White women differ on the features that make a curvaceous body shape attractive. That is, White women will consider slender body types more attractive than Black women and Black women will consider shapely body types more attractive than White women. Black and White women are different in body shapes. An average Black woman is curvier and an average White woman is narrower. They are even different in bone structure. Examples of typical Black African American women who are pear-shaped are Beyoncé Knowles and Serena Williams. There is a difference between being fat and

being curvy and a clear example is illustrated earlier by mentioning the two women who are curvier but not fat.

Puoane, Fourie, Shapiro and Rosling (2005:14) find that the changing perceptions about body weight may be due to media influences, which portray thin images as attractive. The changing perceptions about body weight are confirmed by Gordon-Chipembere (2006:55), on a study undertaken among Black women in rural South Africa, which revealed high levels of body dissatisfaction and disordered eating attitudes among this population group. Gordon-Chipembere (2006:55) explained that a South African journalist, who spent most of her teen years in the United States, was constantly ridiculed and made ashamed of her hips and round buttocks. It was only at age 20, upon her return to South Africa that she was finally able to find peace and familiarity with her body shape because there were many South African women who had the same body shape as hers.

It is evident that, in South Africa, the majority of Black women have prominent buttocks. Mastament-Mason, De Klerk and Ashdown (2012:107) document that body classification based on target market, ensures that consumers within that market will be able to purchase apparel with a better fit.

### 2.11 Jeans sizing system and consumer satisfaction

Glock and Kunz (2005), cited in Shin and Istook (2007:136), argue that a sizing system includes a range of sizes based on graduations of dimensions for a body type. Apparel companies identify body types that are representative of their target customer and develop what they perceive to be appropriate proportions for each size and graduation between sizes. In women's wear, most apparel companies ignore this system and follow their own sizing standards (Glock and Kunz 2005). In designing women's wear, apparel companies do not want to follow a standard sizing system because different firms have different target populations of women, whose lifestyle, incomes and body shapes differ considerably (Alexander 2005:56). Researchers can undertake a national study on different body shapes to produce a sizing system, and any retailer or manufacturer should be able to access these

measurement results in order to achieve a good fit. These fit problems "can reduce high markdowns, lost sales and turnover for companies" (Pisut and Connell 2007:369). Shin and Istook (2007:136) have concluded that fit problems are associated with current sizing systems that overlook the diverse ethnicity that encompasses the full range of variation in body shapes existing in a population.

Sizing to cater for different body shapes in South Africa is a challenge because a consumer who wears one style of a jean in a store might not fit into a different style (Strydom and De Klerk 2010). This poses a challenge for researchers to conduct studies that identify different body shapes, in order to develop size charts and blocks in preparation for jeans development, in local contexts. Posner (2011:104) affirms that understanding customers' needs is essential to all aspects of effective marketing and sales. According to the author (2011), the clothing industry needs to take into consideration, fit issues and garment sizing of different body shapes.

According to Bruner (2012), within the American context, the average woman tries on more than ten pairs of jeans before finding a suitable one (if they find one at all). Simmons and Istook (2003:307) establish that two people are never alike in all of their measurable characteristics. This uniqueness has been the object of curiosity and research for over 200 years.

Writing within a South African context, De Klerk and Tselepis (2007:413) argue that, for most marketers and retailers, it is a priority to provide customer satisfaction. It is a long-term customer-oriented marketing strategy of enterprises to retain loyal customers, who return regularly to the same retailers. It is also a more advisable strategy to keep the present consumers and keep them satisfied, rather than continually looking for new customers or changing focus to different markets. The only true competitive edge is to gain consumer satisfaction. South Africa is a racially diversified country. Hence, the urgency of creating different sizing systems for different body shapes to meet the country's needs cannot be ignored. Olubunmi and Mastamet-Mason (2013) highlight that younger women are becoming plus-size, particularly among 'pear-shaped' South African women of African origin. The ever-

growing fashion awareness amongst Black women in South Africa makes it necessary to develop a sizing chart for the pear-shaped body and to re-evaluate the existing sizing charts in relation to this particular body shape and size category. One needs to take into consideration that, when forecasting fashion trends, body shapes and sizes of consumers should always be a driving force.

Since the late 1980s, anthropologists have set a new research agenda on clothing, placing the body surface at centre stage (Hansen 2004:370). South African National Standard (2008:2) reflects that there is currently no standardisation in the sizing of jeans for the pear-shaped woman in South Africa. According to Millam (2014) from Figure Forms in Cape Town, the 910FF-P model in Figure 2.4 was developed to be a distinctly more Black South African female's pear-shaped body, with a small waist and larger lower hip and thighs. However, this body shape does not represent the majority of Black South African pear-shaped bodies of young women.

Figure 2.4 The 910FF-P Figure Forms


Source: Figure Forms

Figure Forms in Cape Town also developed the '203FF-P' model for ladies' pants. This model was developed for another retailer in Cape Town in 2002 as a specific pants-fitting mannequin. It was then adopted by most of the major retailers in South

Africa, and is still used today as the official Pants/Bottoms mannequin for major South African retailers (Millam 2014). Although this mannequin was adopted by many retailers, the measurements of the mannequin do not match the body shape of the average Black pear-shaped South African woman.

Figure 2.5 The 203FF-P Figure Forms


Source: Figure Forms

The size chart developed for Black South African pear-shaped women from Figure Forms is currently in use by most clothing retailers and manufacturers in South Africa. According to Millam (2014), fit mannequins (models) are not necessarily the exact representation of a human body, but the best tool to create a standard size and fit. Some models are made specifically to represent the exact shaping and proportions of a human body, but other models are made to a standard size that allow the user to fit the widest range of garments on the mannequin and hence create well-fitting garments. Millam (2014) asserts that most of the Figure Forms

mannequins are developed to a retailer's required specifications. It is the retailer that dictates what they think are the best measurements to represent their customers. According to the South African National Standard (2008:2), the garment measurements are normally left to the designers, the retailers or the manufacturers, who are concerned with the style, cut and other fashion elements. A Cape Town-based company in South Africa that develops mannequins similar to the human figure, informed the researcher that their mannequins are based on different sizing systems or charts given to them by different retailers. Each retailer uses its own sizing system based on their target market. This creates confusion for the consumer as sizes vary from retailer to retailer.

Ashdown (2007:60), writing within the American context, mentions that most manufacturers either copy already-developed size charts or use size specifications which they have developed on the basis of knowledge about their current and former customers. Ashdown (2007:60) further reports that sizing systems are often created and adjusted by trial and error, relying on feedback from small consumer surveys and analysis of sales and returned merchandise reports.

### 2.12 Conclusion

Several studies in South Africa revealed that jeans length is not a problem in the country as many women are similar in height. Apeagyei, Phoebe and Mandeya (2010) state, that because of the popularity and versatility of jeans globally, it is important for consumers to be able to purchase well-fitting pairs of jeans based on their selected sizing and fit. Problems identified by several studies indicated problems with jeans gaping at the back waist, dropping to below the back waist or being too tight at the hip area. Rahman (2011:7) states that there has been an on-going challenge for clothing manufacturers to produce well-fitting jeans to satisfy their consumers' needs and aspirations. Hanna (2014) confirms that most jeans bought by female consumers have the same problem of gaping backs. Zwane and Magagula (2007:283) assert that the majority of women with a bottom-heavy figure profile are dissatisfied with the fit of current clothing sizes sold in retail outlets. Muthambi, De Klerk and Mastamet-Mason (2015:70) propose that South Africa is a

multi-cultural society with different ethnic groups; the current South African sizing based on the Western ideal body shape may not necessarily accommodate young South African females of African descent who have a pear-shaped body. Therefore, it means that pear-shaped women rely on custom-made clothing or alterations after purchasing an outfit; or by purchasing different sizes of the same style for the top and bottom.

The following chapter focuses on the research methodology processes used to conduct the study.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1 Introduction

The previous chapter reviewed the literature that focused on different body shapes, the problems associated with the fit of jeans for the indigenous Black consumer in South Africa, consumers' dissatisfaction with fit, jeans sizing and measurements. This chapter discusses the methodological procedures that were followed in order to acquire and analyse data, in order to answer the study's research questions.

## 3.2 Research paradigm

This study employs a positivist's view which, according to Krauss (2005:760), is the idea that observation and measurement are at the core of scientific endeavour. According to the positivist view, the researcher made a point of observing the different pear-shaped bodies (small waist and large hips and thighs) of indigenous Black women in South Africa. A preliminary tape measure test was conducted to select pear-shaped participants for scanning. Thereafter, accurate measurements were obtained by scanning a sample of pear-shaped Black South African indigenous women. The purpose of science is simply to stick to what a person can observe and measure.

## 3.3 Research design

A cross-sectional study was chosen as an appropriate design for this study. Data was obtained from the Cape Peninsula University of Technology, Bellville campus over a period of 27 days. A cross-sectional study is undertaken when data is collected from the population of interest at one point in time (Bowling 2002:195).

## 3.4 Research methods

Quantitative methods were used to collect and analyse data for this research study. According to Johnson and Onwvegbuzie (2004:19), the benefits of using a quantitative research approach is that data collection is relatively quick, providing

precise information and quantifiable numerical data. Data analysis was also relatively less time consuming using SPSS (Statistical Package for Social Science) version 22 for data interpretation. Babbie and Mouton (2002:49) state that quantitative research is the best way to measure properties of the phenomena and emphasis is placed on quantification of variables.

### 3.5 Study area and study population

The research was carried out at the Cape Peninsula University of Technology (CPUT), Bellville campus, which is located in Cape Town's northern suburbs in the Western Cape Province. The choice of confining the study to CPUT was based on two key factors, namely: financial constraints and logistical reasons. The researcher did not have sufficient finances to cover a broader spectrum of the population in a wider geographical area. The most critical factor for confining the study to CPUT was for logistical reasons. CPUT was the only institution of learning in South Africa, at the time of the study, which was known to have a 3D body scanner and moving it to other settings was not feasible.

Bellville is a predominantly Coloured community in the northern suburbs of Cape Town, in the Tygerberg sub-district. According to the Higher Education Management Information Services co-ordinator Wessels (2014), in a personal communication at the Cape Peninsula University of Technology, the university boasts a total number of 32 597 students. About 16 721 were African indigenous Black students, 9 727 of whom were Black South African indigenous female students. Most of this population is based at the Bellville campus, where the scanner is situated in the Technology Station, in the Clothing and Textile Technology Department.

### 3.6 Delimitations

The total number of 60 participants between the ages of 18-35 were scanned for measurements, although the register recorded 83 participants on the first day of recruitment. Only Black South African indigenous female students at the Cape Peninsula University of Technology participated in the study.

A 3D body scanner, housed at CPUT (Bellville campus), was utilised to obtain accurate lower body measurements of pear-shaped Black participants.

### 3.7 Sampling strategy

The procedure used to recruit participants at the Cape Peninsula University of Technology, Bellville campus, was multi-staged sampling. The participants were Black South African indigenous students.

#### 3.7.1 First stage of recruitment

During the first recruitment session, participants were briefed and informed about the nature of the research project as well as the process and implications of their participation. All students were measured using a tape measure to meet the initial eligibility criteria which is a 'South African pear-shape' figure (Mastamet-Mason 2014). Potential participants were measured around the waist and hip circumferences over their outer garments to meet the criteria for scanning. Dates and venue were specified to those who qualified for scanning.

On the first two days of arrival at Bellville campus, posters (Appendix 6) were used as a form of recruitment within the campus. An attendance register was prepared for potential participants to write their names and contact details. The first recruitment process was conducted at the Student Centre. The Library patio was used for measuring (tape measure) participants for inclusion in the study. Participation was hindered by the rainy and cold weather in Cape Town. Students who met the eligibility criteria were requested to be available for body scanning at a prescribed date and time, in the Clothing and Textile Technology Department.

On the third day of arrival at CPUT, the researcher was trained on the 3D body scanner in preparation for scanning participants. The following methods were used to invite student participation:

- Posters were placed in the residences, at the Student Centre and in various academic departments.

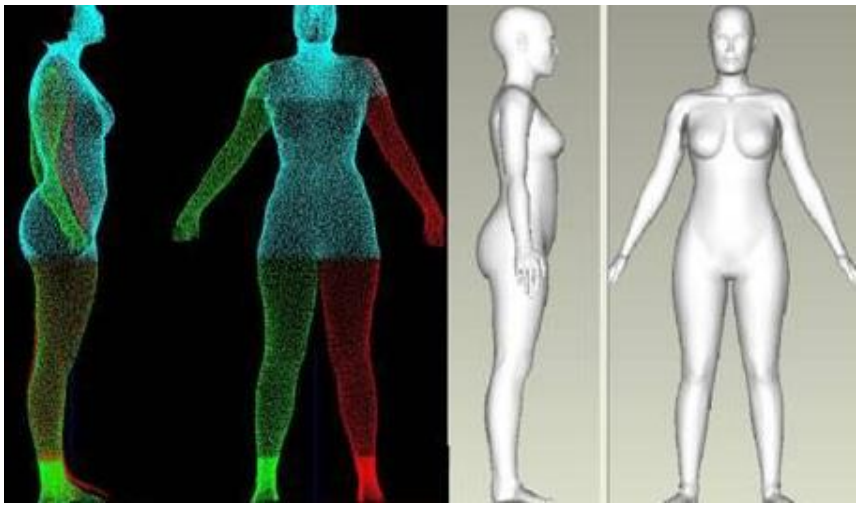
- Various departments were invited through their Heads of Departments and by means of word-of-mouth advertising to attend the presentation. Criteria for participation was a Black South African pear-shaped figure which resembled Saartjie Baartman's body shape (Mastamet-Mason 2014). This type of body shape means a drop value of approximately 39cm and above, between the waist circumference and the hip circumference measurements.

- Word-of-mouth advertising was encouraged and used as an additional marketing strategy at the Student Centre and Library during the first week of arrival at the university. The researcher obtained consent from different student residences and academic departments at the Cape Peninsula University of Technology, Bellville campus. Pre-selection of participants was conducted during weekends at the seven residences, after 4pm, to avoid disruptions during the academic programmes. Pre-selection was also conducted at the respective departments during lunch time (12:45pm-1:30pm). Text messages were sent out, as a reminder, to all participants measured in the pre-selection phase, to arrive for scanning on Monday 9th June 2014, at the Technology Station in the Department of Clothing and Textiles at CPUT's Bellville campus.

### 3.7.2 Second stage of recruitment

On arrival, a classroom next to the scanning venue was used for scanning preparation. Participants were informed on how they should stand and breathe during scanning. Zheng, Yu and Fan (2007:698-699) suggest that, during 3D body scanning, the subject should quietly breathe with shoulders straight, be natural and relaxed. A subject should stand erect with bare and open feet at an angle of about 30 degrees and look straight ahead with arms hanging naturally. Figure 3.1 illustrates how participants were required to stand inside the 3D body scanner, to be scanned for their body measurements.

Figure 3.1 3D body scan images



Source: Polvinen 2012

The potential participants were each given a questionnaire, consent form and information letter to read and complete. After completing the consent form, participants were requested to proceed to a scanning venue. During this session, all selected participants were asked to wear the scanning garments on top of their own underwear for 3D scanning for health and safety reasons. There was an assistant who was administering the register and questionnaires whilst the researcher was operating the 3D body scanner in preparation for the scanning of participants. Initially, only a few participants arrived at the scanning venue due to poor weather conditions and other unknown reasons. An incentive was then set up by the researcher for recruiting more participants. Participants who were scanned received R10.00 for every eligible participant they brought into the scanning venue.

Those who did not fall within the pear-shaped figure criteria, were thanked for their time and were requested not to participate in the study. Those identified as eligible to participate in the study were requested to proceed for scanning. The TC2 NX12 3D body scanning technology, which uses a safe white light (with no lasers or radiation sources), was utilised to scan the participants. Each participant entered the scanner changing cubicle individually, to change into the scanning garments. They were each given a laundered, sealed pack containing a grey bra and bikini for being scanned,

as this colour delivered the best results for scanning. The TC2 NX12 3D non-contact body scanner, scanned the whole body in a few seconds and provided a list of extracted body measurements. Participants at CPUT all went through the same procedure of scanning during the same period (June and July 2014).

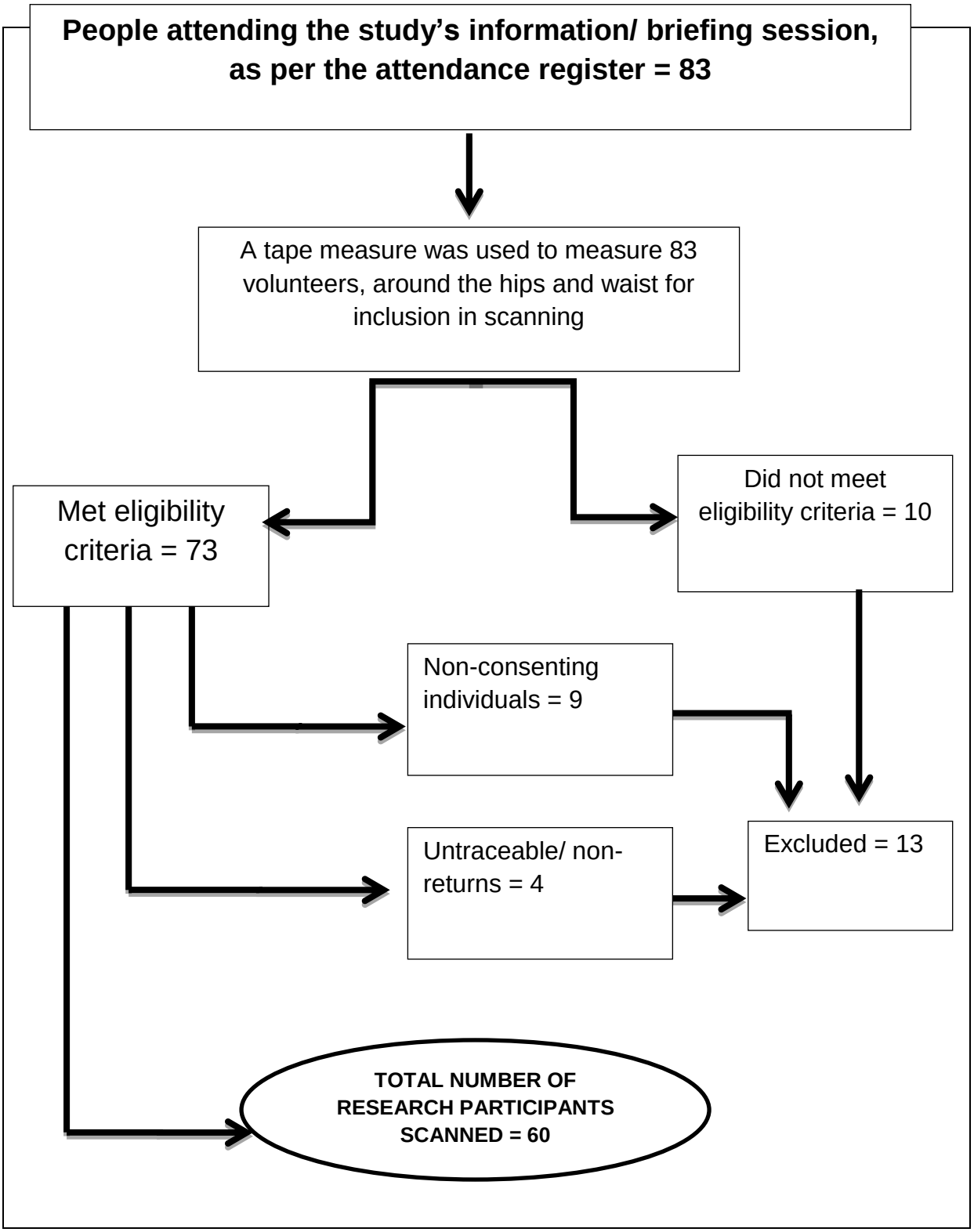
In summary, the following stages of sampling, referred to as the multi-staged sampling, were followed:

Stage 1: All South African Black indigenous women (students) were invited to attend the information session of the study at Bellville campus, Department of Clothing and Textile Technology;

Stage 2: After the presentation, all women were measured at the waist and hip line using a tape measure; and

Stage 3: All those whose waists and hip measurements fell within the pear-shaped eligibility range were requested to participate after completing the short questionnaire, and then to proceed for scanning. At this stage, all those who did not meet the required measurements, were excluded from the study. A participant selection flow chart is presented in Figure 3.2.

Figure 3.2 Participant's selection flow chart




Source: Self-generated

### 3.8 Inclusion criteria

All participants included in the study were between 18-35 years of age. These students responded to invitations, met the eligibility criteria and signed a letter of informed consent for participation in the study.

### 3.9 Data collection technique

According to Punch (2005:85), quantitative data are in the form of numbers and measurements are the process by which data are turned into numbers.

Quantitative questionnaire: Black female participants responded to a questionnaire (Appendix 3) in order to provide information on their experience as customers when purchasing jeans. The questionnaire was structured consisting of closed-ended questions. Jason (2011:41) asserts that the advantages of closed-ended questions is that they provide greater uniformity of responses resulting in data being more accurate, easier to understand and to interpret. These types of questionnaires are economical, efficient, easy to process, lack interviewer bias and the possibility of anonymity and privacy is provided (2011:41).

Measurement: The [TC]2 NX12 3D body scanning technology, which uses a safe white light (with no lasers or radiation sources), was utilised to scan the participants. The 3D body scanning took place at the Cape Peninsula University of Technology's, Clothing and Textiles Technology Station. Approximately 5 to 10 participants were scanned per day. The researcher was available at all times for scanning.

In order to avoid problems which could occur when taking body measurements manually, a 3D body scanner was used to extract accurate body measurements. The waist and the hip drop value (difference in the waist and hip circumference measurements) were the most significant measurements that differentiates a South African pear-shaped figure from a western pear-shaped body, due to problems of exaggerated gaping in the back waist.

### 3.10 Data processing

Gupta and Gangadhar (2004:458) confirm that the process of developing body size charts involves taking anthropometric body measurements of the target population and its division into homogeneous groups for the purpose of garment manufacture. The Figure Form experts were consulted to advise on key measurements that are strongly associated with jeans size charts.

### 3.11 Data analysis

Methods used for analysing the questionnaire and scanned data are discussed below.

#### 3.11.1 Questionnaire analysis

1. Similar responses from the questionnaire were coded manually.
2. Coded data was uploaded onto a SPSS spread sheet.
3. Percentage frequency results from SPSS were displayed on graphs.

#### 3.11.2 Scanned measurements analysis

1. Raw measurements were coded manually according to similarly categorised measurements.
2. Five groupings of measurements were established (see Table 4.1 to Table 4.10).
3. Scanned measurements were uploaded on SPSS to obtain the mean values, standard deviation, maximum and minimum values.
4. Mean values were used to develop the sizing system.
5. SPSS results provided the incremental value between each size.
6. A table of measurements was presented as a sizing system for the Black South African pear-shaped body.
7. A size 12 block and a master pattern were developed to construct a jeans sample, to test fit.
8. The size 12 master pattern was graded down to a size 10 and up to a size 14 to construct sample garments to test fit.

### 3.12 Validity and reliability

According to Bowling (2002:147) validity is an assessment of whether an instrument measures what it aims to measure. Reliability refers to the stability of the research instrument (Maree 2010:147). A 3D body scanner was used to scan participants to extract reliable and accurate measurements for the new jeans sizing system, for Black pear-shaped women. The waist, abdomen and hip measurements were identified as key measurements to be implemented for the new jeans size chart.
The design of the questionnaire was refined with input from colleagues.

### 3.13 Ethical considerations

Data collected from print and online published works have been acknowledged and referenced accordingly. Ethical clearance for this study was obtained from the Durban University of Technology's Institutional Research Ethics Committee (IREC) (Appendix 4).

Letters from the researcher and the co-supervisor (Appendix 2a and 2b) were emailed to Dr Hovgaard (HOD Department of Clothing and Textile Technology-CPUT) and Mr Isaacs (Technology Station Manager-CPUT), requesting permission to utilise the body scanner from 1 May to 30 June 2014. Mr Tembo, the Chief Director for Clothing and Textiles unit at the Department of Trade and Industry in Pretoria, intervened on my behalf to utilise the body scanner at CPUT at no charge, as the study was for research purposes.

Permission from the involved departments at the Cape Peninsula University of Technology was obtained to recruit participants. During fieldwork, the researcher explained the aim of the study and sought informed consent (Appendix 5) for body scanning and questionnaire completion from each participant. Even though a 3D body scanner is a non-contact technology, participants who had fears, reservations and/ or discomfort were allowed to withdraw from the study at any time they felt uncomfortable. Anonymity and confidentiality were afforded to participants and their names were not used in the study.

### 3.14 Limitations

It was a challenge to recruit participants to be scanned for measurements as the scanning procedure involved some undressing. Some participants were not comfortable with the idea of undressing although participants were told that privacy would be afforded to change into scanning garments.

This research was conducted during rainy and cold weather in Cape Town, while students were busy preparing for June examinations. The only period for the scanning technology to be available for use by an outsider for research purposes was during this time; as during normal university days, it is being used for academic and other research purposes. Most students did not have time to come to the scanning venue as they were busy with examinations. The small number of individuals that were scanned per day was demotivating; two to five subjects per day were scanned. Sometimes a day would go by without receiving even one subject to be scanned for measurements.

The Department of Clothing and Textile Technology at the Cape Peninsula University of Technology is an extensive walking distance to the Student Centre where many students were available and reachable. The distance to the Clothing and Textile Technology Department also contributed to poor participation. The option to relocate the 3D body scanner to the Student Centre for scanning would have been quite an expensive exercise as the 3D body scanner has to be disassembled and reassembled by a specialist. The budget was very limited for the study and it was concluded that the scanner would remain within the premises of the department. For future studies, the venue for scanning should be easily accessible to attract more participation, when conducting a study of this nature.

### 3.15 Conclusion

This chapter highlighted and discussed the in-depth procedures followed in order to obtain and analyse the necessary data for deriving the findings. The results from the data collection will be presented in the following chapter.

# CHAPTER 4

# RESEARCH FINDINGS AND PRODUCT ANALYSIS

## 4.1 Introduction

Chapter 3 discussed the research methodology selected for the study. This chapter presents body measurement findings for the development of a jeans sizing system for young Black South African pear-shaped woman. The sample used for scanning young Black South African pear-shaped woman at the Cape Peninsula University of Technology in South Africa. Data from the completed survey questionnaires was captured into SPSS (Statistical Package for Social Science version 22), and coded prior to analysis. The software was utilised to quantify measurements of the participants and present data in a manner that responds to the research objectives of the study. The findings are presented and discussed in this chapter.

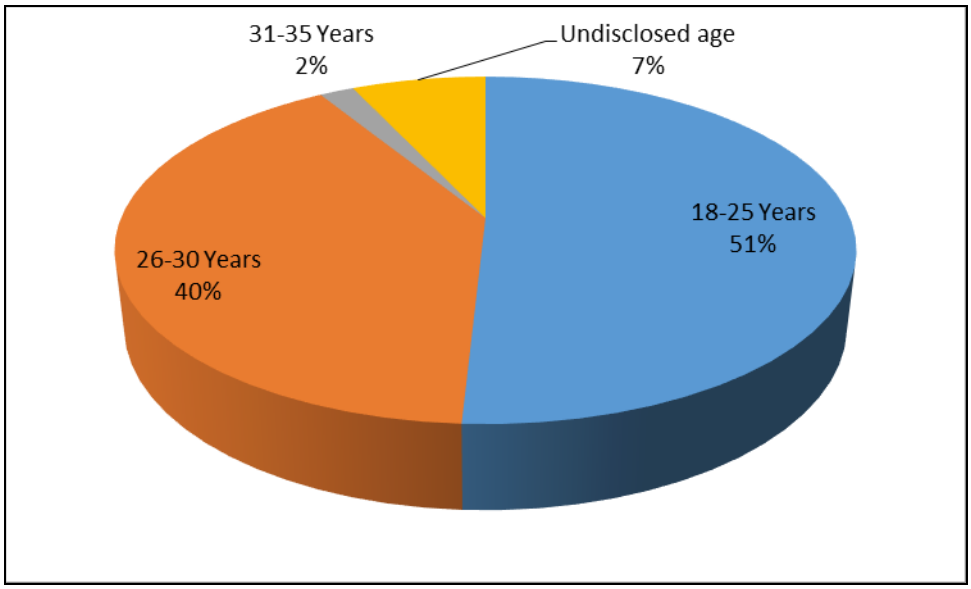
Within the context of this study, the scanned measurements are considered the most critical variables for the development of a jeans sizing system for the pear-shaped Black South African body. Body measurement differences were examined at the waist, hips, body rise, crotch, crotch to knee, waist to hip, knee width, inseam (inner leg length) and outseam (outer leg length). According to Shin and Istook (2007:138), these are the key measurements that impact on the fit of a pair of jeans. Consistent with the findings of Shin and Istook (2007), Hsu and Wang (2005:670) assert that the waist drop measurement is the most important variable in establishing sizing systems of pants in garment making.

## 4.2 Respondents' biographical information

Notably, not all respondents who participated in the scanning exercise responded to the questionnaire. Only 57 out of the 60 women scanned, responded to the questionnaire. The first section of the chapter focused on gathering biographic data and respondents' experiences from the questionnaire, in so far as jeans fitting and sizing are concerned. The second section of the chapter presented the jeans sizing system obtained from the analysis of scanned measurements. The sizing system

was compared to Aldrich's British sizing system (2008).

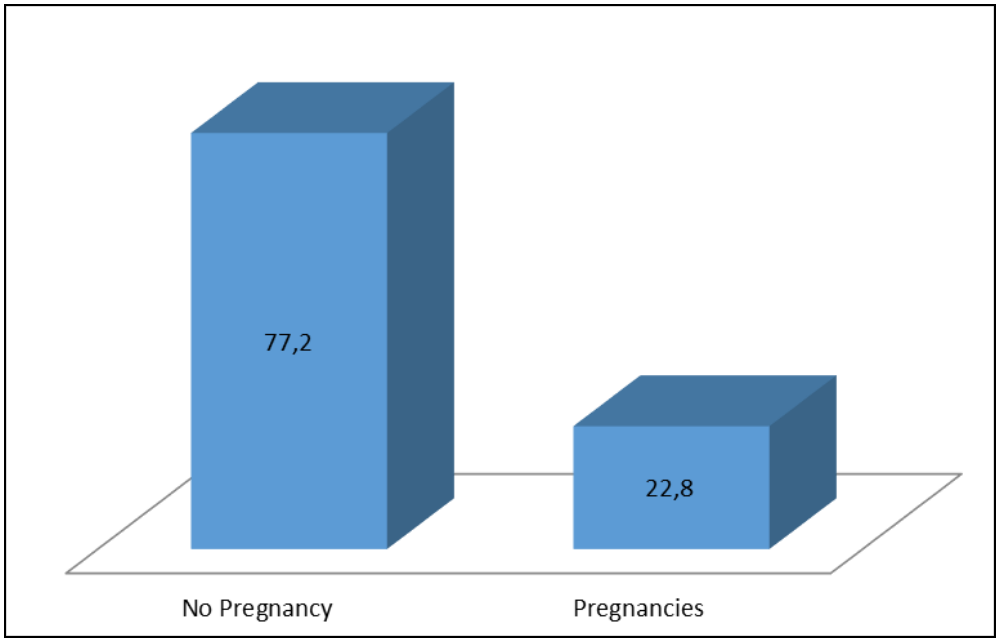
**Figure 4.1 Respondents' ages at last birthday (n=57)**




The majority of the participants 51% were in the age group category of 18-25 years. 40% of the participants were between the ages of 26-30 and 2% were between the ages of 31-35 years, respectively. 7% of the participants were uncomfortable in sharing their ages, and this increased the margin of error and reduced the depth of data. This section enabled the researcher to identify the different age groups that participated in the study and different problems encountered by them with regards to jeans size and fit. Van Huyssteen (2006:1) reveals that the human body changes in width as age increases; therefore, it is important to consider that figure types may not necessarily look the same even if they all have the Black South African pear-shaped body. The researcher concurs with this assertion because it became clear, while this study was being conducted, that, while most Black women have a South African pear-shaped body, that shape manifests in different ways. For example, some women have narrower waists with prominent buttocks and sharp hips, others have narrower waists with flatter buttocks and sharp hips, while others have narrower waists with flatter hips, but prominent buttocks. The same South African

pear-shape can thus be sub-categorised to present a holistic picture of the way women look in this country.

**Figure 4.2 Respondents' pregnancy data (n=57)**




This question was asked to establish if the participants experienced any changes in their body shapes after child bearing. Figure 4.2 reveals the pregnancy data of the respondents. The majority of the respondents (77.2%) had never been pregnant. Most of their abdomens were slightly flat because they had never had children. Those who were previously pregnant, (22.8%) revealed that their bodies changed, some lost weight and some gained. Those who gained, revealed that even after they tried to lose weight, some parts like breasts, abdomen and hips did not necessarily fall back into the same places that they were in, before they had children. Some participants now had fuller figures and bigger abdomens. Some complained of having stretch marks, excess skin and a bit of belly fat which was impossible to burn or flatten.

**Figure 4.3 Home provinces of the research participants (n=57)**

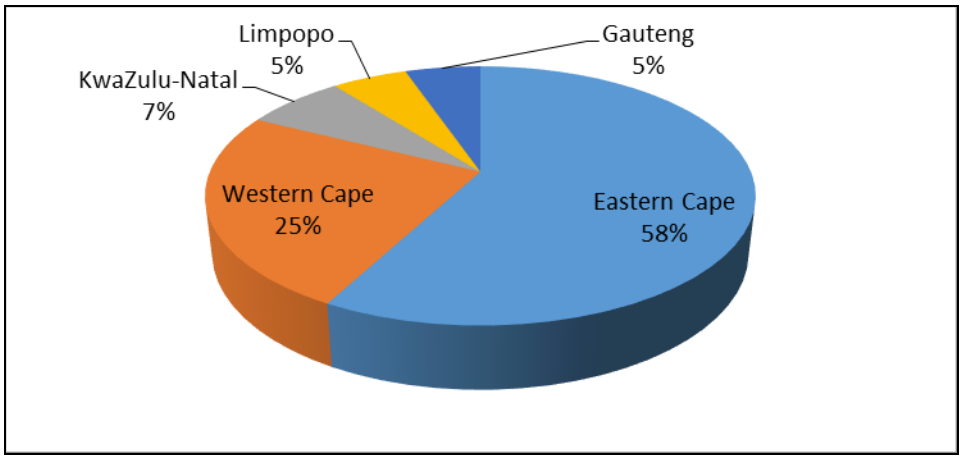
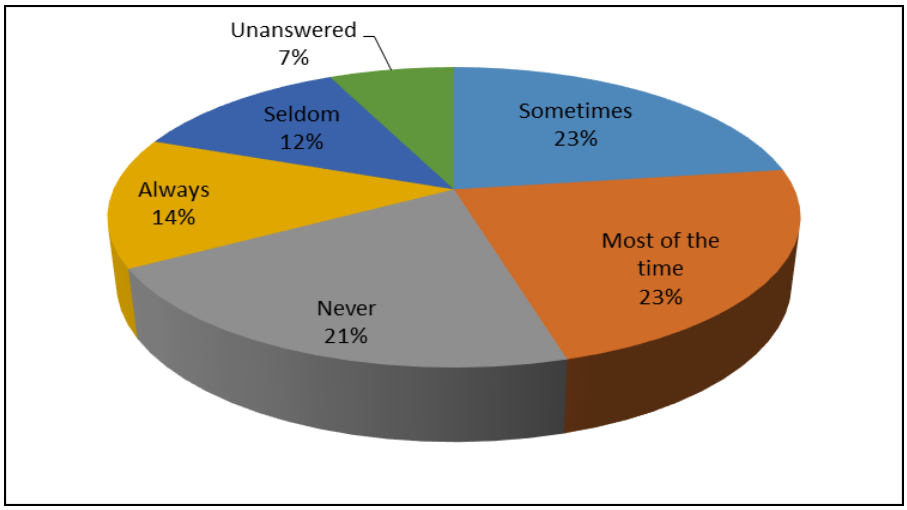



Figure 4.3 identifies the home provinces of the respondents. Respondents from five provinces in South Africa participated in the research. The largest percentage of the respondents (58%) were from Eastern Cape, followed by Western Cape at 25%, KZN at 7%, Limpopo at 5%, and Gauteng at 5%. This question was asked to establish the representation of jeans fit problems within South Africa and also to establish the pear-shaped jeans market in these provinces. A larger representation of Black women from the Eastern Cape showed interest in the study.

**Figure 4.4 Respondents' experiences on gaping at the waist back (n=57)**




In total 37% of the participants encountered problems with gaping at the waist back, because of larger hips and smaller waistlines. 23% of the participants experienced this problem sometimes, while 33% seldom or never had a problem with fit. In summary, more than 60% of the respondents indicated fit problems with gaping at waistline. The assumption with *'gaping'* is that prominent buttocks may pull the jeans backwards from waist to hip, causing the back waist to gape. The diagram below depicts an example of gape in the back waist.

Figure 4.5 Gaping in the back waist

Source: Jha 2014

**Figure 4.6 Experiences on tight fitting around front waistline (n=57**

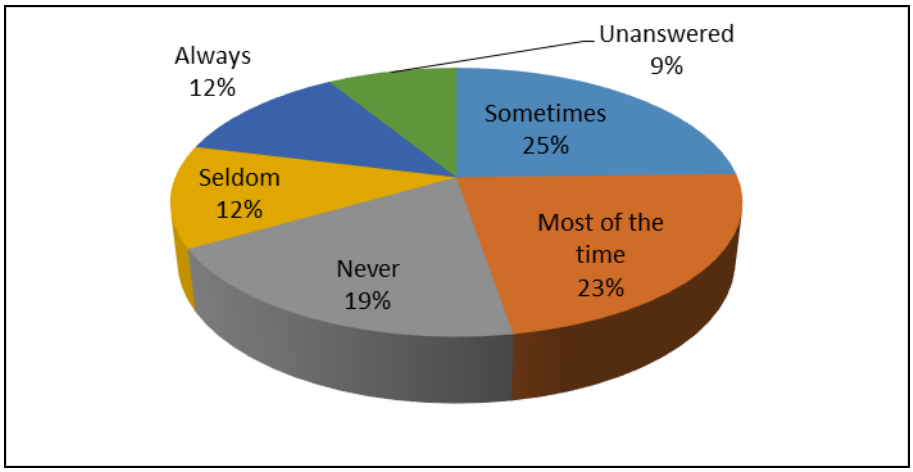



Figure 4.6 illustrates that 35% of the sample experienced a tight fit around the front waistline always or at most times. 25% encountered this problem sometimes, while 31% seldom or never experienced this problem. The respondents were asked to rate the fitting problems around the front waistline regarding tight fitting. The assumption is that when jeans gape at the waist back, it pulls the front waistline to the back causing a tight fit and discomfort across the tummy area.

**Figure 4.7 Experiences in finding a perfect pair of jeans (n=57)**

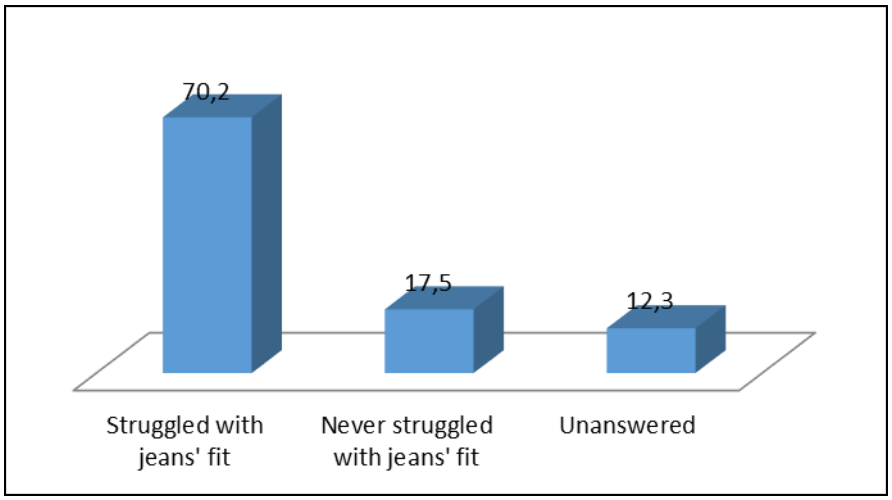


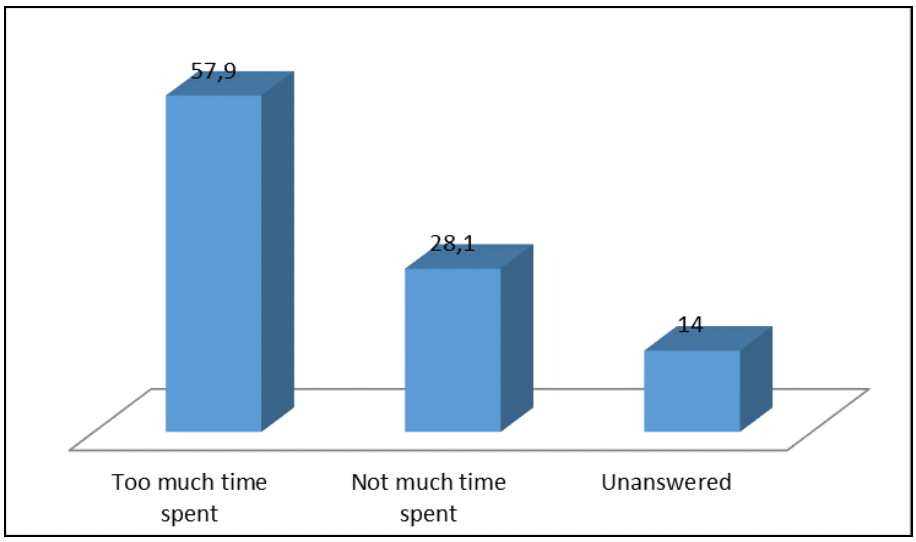

Figure 4.7 shows that the largest percentage of the respondents 70.2% struggled to find jeans that fit them correctly, 17.5% of respondents never had problems in finding well-fitting jeans. 12.3% of the respondents did not answer.

Figure 4.8 Jeans fit on a pear-shaped woman at a retail outlet

Source: Self-generated

Participants tried different jeans brands in South Africa at leading retail outlets, but most participants seemed to struggle with finding well-fitting jeans. Gaping in the back waist was the most common stated problems experienced by participants.

**Figure 4.9 Experiences in time spent trying on jeans (n=57**




According to Figure 4.9, 57.9% of participants spent a great deal of time trying on jeans at retail outlets and not being able to find a perfectly fitting pair of jeans. 28.1% of participants did not spend too much time trying on jeans (managed to find jeans) and 14% did not answer this question. Levis Curve ID (2011) reveals that curvier women have the most difficult time when trying on jeans in their search to find a well-fitting pair of jeans. In relation to this assertion, the researcher found that Black South African pear-shaped women try several styles of jeans before making a selection. As overwhelming as this problem is, they still have to incur the cost of tailor adjustments to obtain the correct fit.

### 4.3 Interpretation of data collection

In this chapter, the research findings are presented according to the two critical research questions identified for the study in chapter one:

1. **What are the experiences of Black South African pear-shaped women with regard to jeans fit and measurements currently in stores in South Africa?**

In response to a request for general comments in the questionnaire, the majority of the participants felt it is important that jeans in retail outlets need to fit the majority of Black South African pear-shaped bodies. A total of 35% of these women indicated

an uncomfortably tight fit around the front waist to hip area and gaping at the back waistline. 25% of the respondents indicated that jeans could sometimes cause all these discomforts depending on the jeans' brand and styling. Respondents mentioned having always to spend more money by taking their jeans to a tailor for alterations of the fit at the waist. Most respondents suggested that they preferred the jeans to sit on the natural waistline, which flattens the buttocks and emphasises a well-defined waistline.

**2. What are the key body measurements related to jeans fit for the Black South African pear-shaped indigenous women?**

A well-fitting pair of jeans cannot be possible without a set of body measurements taken from a representative group of the target population. A 3D body scanner was used to collect these measurements as a means of constructing size charts and sizing systems. Analysis of raw measurements (data) was based on clustering of similar waist and hip measurements. See Tables 4.1, 4.3, 4.5, 4.7 and 4.9. for clustering of measurements for sizes 10 to size 18. All drop value measurements of 38cm and below in Cluster A (size 10) were eliminated from Table 4.1.

All raw measurements that appear in Appendix 8 are not reflected in the cluster tables listed from Tables 4.1 to 4.5. The researcher looked at the 'extreme' Black South African pear-shaped body due to problems of gaping, and only a drop value of 39cm and above was included in the cluster tables in preparation for the development of a jeans sizing system. The measurements were applied within the minimum, maximum, mean and standard deviation of each of the ten variables, to develop the jeans block. The ten measurements used were: waist, body rise, hip, knee width, calf, outseam, inseam, crotch, crotch to knee, waist to hip. Waist and hip measurements in this study were the key measurements that were used as deciding factors on size designations.

The bust measurement in this study was used to determine the Black South African pear-shaped body. The Black South African pear-shaped hip measurement is generally 30cm larger than the bust (Mastamet-Mason 2012). The bust and under bust in all the clusters were used to determine the body shape.

Participants' who measured below the drop value of 38cm were eliminated from all Tables 4.1 to 4.5. The mean values of the participants express the body measurements of the average 18-35 year-old Black South African pear-shaped indigenous women.

Raw data of scanned participants is presented in Tables 4.1 (size 10), 4.3 (size 12), 4.5 (size 14), 4.7 (size 16) and 4.9 (size 18). These measurements were analysed and used to calculate the mean, minimum, maximum, standard deviation and average measurements in Tables 4.2, 4.4, 4.6, 4.8 and 4.10. The mean values in Tables 4.2, 4.4, 4.6, 4.8 and 4.10 derived from Tables 4.1, 4.3, 4.5, 4.7 and 4.9 were the critical measurements used to develop a new sizing system for the Black South African pear-shaped figure.

The frequency distribution Tables of participants are presented in Appendices 9.1 to 9.5. Not all the 65 anthropometric variables were useful for establishing the sizing systems for jeans as per appendix 7.

Measurements from Table 4.11 were used to construct a sample pair of jeans in 100% cotton denim fabric to test fit. A mock-up was constructed to check fit and shape and fitting trials were conducted at this stage. Alterations on the mock-up and block pattern were made to improve fit. A size 12 block and master pattern was corrected after alterations were made and was perfected.

The size 12 (waist 75.5cm and hip 116cm) block pattern was graded down to a size 10 and up to a size 14 to construct sample jeans to test fit (see Figure 4.10). Pockets were excluded from this jeans sample as the focus was on fit. A good fit is determined by a well-engineered block pattern which is a base pattern. For the purpose of this study, a block pattern was developed to test fit, which was then used to cut out 100% cotton denim fabric to sew a jeans sample depicted in Figure 4.10. The sizing system developed was based on the measurements of the participants and therefore cannot be generalised to a larger population.

**Table 4.1 Cluster A - size 10**

| Body measurements sheet in centimetres (n=60) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip | Drop-waist & hip |
| 161 | 85 | 71 | 113 | 42 | 71 | 82 | 72 | 102 | 28 | 33.7 | 20 | 42 |
| 167 | 85 | 68 | 107 | 41 | 68 | 74 | 83 | 106 | 27 | 33.9 | 19.7 | 39 |
| 150 | 90 | 70 | 114 | 42 | 68 | 78 | 64 | 94 | 28 | 32 | 20 | 44 |
| 150 | 85 | 73 | 117 | 42 | 68 | 82 | 65 | 95 | 28 | 33.1 | 20 | 44 |
| 158 | 89 | 70 | 110 | 40 | 69 | 76 | 71 | 97 | 28 | 33.7 | 20 | 40 |
| 159 | 87 | 69 | 110 | 41 | 75 | 76 | 76 | 101 | 27 | 34 | 20 | 41 |
| 152 | 91 | 71 | 113 | 41 | 77 | 81 | 67 | 98 | 27 | 33 | 20 | 42 |
| 158 | 90 | 71 | 114 | 41 | 73 | 82 | 69 | 96 | 27 | 34 | 20 | 43 |
| 158 | 93 | 73 | 113 | 41 | 72 | 78 | 76 | 100 | 27 | 34 | 20 | 40 |
| 158 | 88 | 69 | 110 | 40 | 72 | 76 | 67 | 98 | 26.5 | 34 | 20 | 41 |
| 160 | 87 | 68 | 113 | 42 | 71 | 78 | 70 | 102 | 27 | 34.3 | 20 | 45 |
| 167 | 89 | 67 | 107 | 42 | 69 | 75 | 84 | 107 | 26.7 | 34.6 | 19.7 | 40 |
| 169 | 87 | 72 | 114 | 41 | 71 | 86 | 79 | 108 | 28 | 34.9 | 20 | 42 |
| 166 | 86 | 68 | 111 | 41 | 68 | 76 | 76 | 104 | 26 | 34.3 | 20 | 43 |
| 153 | 89 | 69 | 107 | 41 | 74 | 76 | 67 | 98 | 26 | 33.1 | 20 | 40 |
| 166 | 96 | 71 | 117 | 42 | 79 | 85 | 71 | 99 | 28.7 | 34 | 20 | 46 |
| 162 | 81 | 70 | 111 | 42 | 68 | 85 | 71 | 102 | 27 | 34 | 20 | 41 |
| 164 | 85 | 73 | 119 | 42 | 73 | 92 | 74 | 102 | 28 | 34 | 20 | 46 |
| 161 | 89 | 72 | 111 | 42 | 71 | 84 | 66 | 103 | 28 | 34 | 20 | 39 |

Table 4.1 presents clustered body measurement data for a size 10, based on waist measurements of 68 cm to 73 cm and hip measurements of 107 cm to 119 cm.

**Table 4.2 Statistics Cluster A - size 10**

| | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 87.5 | 70 | 113 | 41 | 71 | 78 | 71 | 100.5 | 27 | 34 | 20 |
| **Minimum** | 81 | 67 | 107 | 40 | 68 | 74 | 67 | 94 | 26 | 32 | 19.7 |
| **Maximum** | 96 | 73 | 119 | 42 | 79 | 92 | 84 | 108 | 28 | 34 | 20 |
| **Standard deviation** | 3.4 | 1.85 | 3.45 | 0.68 | 3.29 | 4.8 | 5.78 | 4.03 | 0.70 | 0.70 | 0 |
| **Average** | 88 | 70 | 113 | 42 | 73 | 84 | 73 | 103 | 27 | 33.1 | 21 |

The mean body measurement from Table 4.2 was selected to contribute to a sizing system for a size 10 jean, as presented in Table 4.11 (final sizing system).

**Table 4.3 Cluster B - size 12**

| Body measurements sheet in centimetres (n=60) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Height** | **Bust** | **Waist full** | **Hips full** | **Knee** | **Under bust** | **Crotch full** | **In seam** | **Out seam** | **Body rise** | **Crotch to knee** | **Waist to hip** | **Drop-waist & hip** |
| **161** | **87** | **76** | **116** | **42** | **70** | **79** | **70** | **97** | **28** | **33.5** | **21.1** | **40** |
| **167** | **92** | **74** | **116** | **42** | **71** | **75** | **72** | **99** | **28** | **34** | **20** | **42** |
| **158** | **93** | **80** | **119** | **43** | **76** | **82** | **69** | **96** | **32** | **34** | **21.9** | **39** |
| **165** | **93** | **75** | **119** | **43** | **76** | **87** | **69** | **98** | **32.5** | **34.2** | **20** | **44** |
| **167** | **90** | **74** | **116** | **44** | **74** | **86** | **73** | **104** | **28** | **34.6** | **20** | **42** |
| **158** | **93** | **76** | **117** | **42** | **75** | **85** | **71** | **97** | **28** | **34** | **20** | **41** |
| **162** | **97** | **76** | **113** | **43** | **76** | **85** | **76** | **102** | **27** | **34** | **20** | **41** |
| **167** | **90** | **74** | **116** | **42** | **74** | **86** | **76** | **107** | **28** | **34.5** | **20** | **42** |
| **165** | **88** | **74** | **116** | **42** | **75** | **86** | **73** | **100** | **28** | **34.2** | **20** | **42** |
| **166** | **91** | **76** | **117** | **42** | **73** | **86** | **71** | **98** | **28** | **34.1** | **20** | **41** |
| **159** | **101** | **80** | **119** | **42** | **87** | **82** | **70** | **97** | **28** | **34** | **20** | **39** |

Table 4.3 presents clustered body measurement data for a size 12, based on waist measurements of 74 cm to 80 cm and hip measurements of 113 cm to 119 cm.

**Table 4.4 Statistics Cluster B - size 12**

| | **Bust** | **Waist full** | **Hips full** | **Knee** | **Under bust** | **Crotch full** | **In seam** | **Out seam** | **Body rise** | **Crotch to knee** | **Waist to hip** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | **92** | **76** | **116** | **42** | **75** | **85** | **71** | **98** | **28** | **34** | **20** |
| **Minimum** | **88** | **74** | **113** | **42** | **70** | **75** | **69** | **96** | **27** | **33.5** | **20** |
| **Maximum** | **101** | **80** | **119** | **43** | **87** | **87** | **76** | **107** | **32.5** | **34.6** | **21.9** |
| **Standard deviation** | **3.97** | **2.21** | **1.79** | **0.68** | **4.04** | **3.72** | **2.48** | **3.44** | **1.33** | **0** | **0** |
| **Average** | **95** | **76** | **117** | **42** | **80** | **87** | **73** | **101** | **33** | **33.6** | **21.2** |

The mean body measurement from Table 4.4 was selected to contribute to a sizing system for a size 12 jean, as presented in Table 4.11 (final sizing system).

**Table 4.5 Cluster C - size 14**

| Body measurements sheet in centimetres (n=60) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip | Drop-waist & hip |
| 173 | 88 | 79 | 121 | 43 | 77 | 89 | 80 | 109 | 28.9 | 35.5 | 20.3 | 42 |
| 162 | 99 | 80 | 121 | 43 | 82 | 89 | 76 | 102 | 33 | 34.7 | 20.8 | 41 |
| 168 | 98 | 81 | 121 | 43 | 78 | 89 | 78 | 106 | 28 | 34 | 20 | 40 |
| 159 | 99 | 78 | 120 | 43 | 78 | 87 | 72 | 97 | 33 | 34 | 20.5 | 40 |
| 161 | 98 | 78 | 120 | 42 | 81 | 87 | 73 | 102 | 33.5 | 34 | 20.7 | 42 |
| 161 | 98 | 80 | 121 | 43 | 77 | 87 | 69 | 97 | 33.5 | 34 | 20.8 | 41 |
| 160 | 92 | 79 | 123 | 43 | 76 | 86 | 69 | 94 | 33.6 | 34 | 20.9 | 44 |

Table 4.5 presents clustered body measurement data for a size 14, based on waist measurements of 78 cm to 81 cm and hip measurements of 120 cm to 123 cm.

**Table 4.6 Statistics Cluster C - size 14**

| | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 98 | 79 | 121 | 43 | 78 | 87 | 73 | 102 | 33 | 34 | 20 |
| **Minimum** | 88 | 78 | 120 | 42 | 76 | 86 | 69 | 94 | 28 | 34 | 20 |
| **Maximum** | 99 | 81 | 123 | 43 | 89 | 89 | 80 | 109 | 33.6 | 33.5 | 20.9 |
| **Standard deviation** | 4.28 | 1.1 | 1 | 0.37 | 2.2 | 1.25 | 4.29 | 5.35 | 2.88 | 0 | 0 |
| **Average** | 97 | 79 | 122 | 43 | 77 | 86 | 66 | 93 | 28.10 | 35.6 | 20.13 |

The mean body measurement from Table 4.6 was selected to contribute to a sizing system for a size 14 jean, as presented in Table 4.11 (final sizing system).

**Table 4.7 Cluster D - size 16**

| Body measurements sheet in centimetres (n=60) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In sea m | Out seam | Body rise | Crotch to knee | Waist to hip | Drop-waist & hip |
| 160 | 99 | 86 | 126 | 44 | 80 | 88 | 69 | 94 | 35 | 33.4 | 21.8 | 40 |
| 167 | 108 | 84 | 125 | 43 | 83 | 87 | 75 | 103 | 34.5 | 34.4 | 21.5 | 42 |
| 152 | 105 | 82 | 124 | 43 | 88 | 88 | 67 | 100 | 34.5 | 33.3 | 21.3 | 42 |

Table 4.7 presents clustered body measurement data for a size 16, based on waist measurements of 82 cm to 86 cm and hip measurements of 124 cm to 126 cm.

**Table 4.8 Statistics Cluster D - size 16**

| | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 105 | 84 | 125 | 43 | 83 | 88 | 69 | 100 | 35 | 34 | 21 |
| **Minimum** | 99 | 82 | 124 | 43 | 80 | 87 | 67 | 94 | 34.5 | 33.3 | 21.3 |
| **Maximum** | 108 | 86 | 126 | 44 | 88 | 88 | 75 | 103 | 35 | 34.4 | 21.8 |
| **Standard deviation** | 4.58 | 2 | 1 | 0.57 | 4.04 | 0.57 | 4.16 | 4.58 | 0 | 0 | 0 |
| **Average** | 110 | 80 | 123 | 42 | 92 | 88 | 68 | 105 | 35 | 33.5 | 21.8 |

The mean body measurement from Table 4.8 was selected to contribute to a sizing system for a size 16 jean, as presented in Table 4.11 (final sizing system).

**Table 4.9 Cluster E - size 18**

| Body measurements sheet in centimetres (n=60) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip | Drop-waist & hip |
| 155 | 109 | 91 | 130 | 44 | 91 | 88 | 65 | 97 | 35.8 | 33,2 | 21.7 | 40 |
| 153 | 102 | 89 | 132 | 45 | 83 | 92 | 75 | 100 | 36.8 | 34 | 22.7 | 43 |
| 153 | 103 | 90 | 133 | 45 | 91 | 90 | 67 | 98 | 36.5 | 33.9 | 22 | 39 |
| 166 | 113 | 99 | 138 | 45 | 96 | 94 | 72 | 99 | 38 | 34.1 | 22.9 | 39 |
| 161 | 109 | 93 | 134 | 42 | 91 | 94 | 75 | 102 | 38.5 | 34 | 21.9 | 41 |

Body measurements are inconsistent in Table 4.9 due to a relatively small sample population.

Table 4.9 presents clustered body measurement data for a size 18, based on waist measurements of 89 cm to 93 cm and hip measurements of 130 cm to 138 cm.

**Table 4.10 Statistics Cluster E - size 18**

| | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 109 | 91 | 133 | 45 | 91 | 92 | 72 | 99 | 38 | 34 | 22 |
| Minimum | 102 | 89 | 130 | 42 | 83 | 88 | 65 | 97 | 35.5 | 33.2 | 21.7 |
| Maximum | 113 | 99 | 138 | 45 | 96 | 94 | 75 | 102 | 38.5 | 34.1 | 22.9 |
| Standard deviation | 4.6 | 3.97 | 2.96 | 1.3 | 4.66 | 2.6 | 4.6 | 1.9 | 0 | 0.46 | 0 |
| Average | 109 | 93 | 134 | 42 | 91 | 94 | 75 | 102 | 38.5 | 34 | 21.9 |

The mean body measurement from Table 4.10 was selected to contribute to a sizing system for a size 18 jean, as presented in Table 4.11 (final sizing system).

Drop values in the last columns of Tables 4.1, 4.3, 4.5, 4.7 and 4.9 identify the difference between waist and hip measurements in order to determine the Black South African pear-shaped body. Cluster analysis in Tables 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 and 4.10 were used to determine the sizing criteria and establish a size measurement chart. The minimum and maximum values of each of the five clusters were determined by using the waist and hip measurements means and standard deviations to develop a jeans sizing system.

### 4.4 Developing a sizing system

In developing a new jeans sizing system for the Black South African pear-shaped figure, mean values of the 11 variables (Table 4.11) were calculated and used as key measurements for the sizing system.

**Table 4.11 Jeans sizing system**

| Sizes | Drop Values (Waist & hip) | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 43 | 87.5 | 70 | 113 | 41 | 71 | 78 | 71 | 100.5 | 27 | 34 | 20 |
| 12 | 40 | 92 | 76 | 116 | 42 | 75 | 85 | 71 | 98 | 28 | 34 | 20 |
| 14 | 42 | 98 | 79 | 121 | 43 | 78 | 87 | 73 | 102 | 33 | 34 | 20 |
| 16 | 41 | 105 | 84 | 125 | 43 | 83 | 88 | 69 | 100 | 35 | 34 | 21 |
| 18 | 42 | 109 | 91 | 133 | 45 | 91 | 92 | 72 | 99 | 38 | 34 | 22 |

For the purpose of this study, increments or intervals between sizes were not created. Measurements presented in Table 4.11 may be somewhat inconsistent because of the small sample population. However, Van Huyssteen (2006:7) asserts that increments are not necessarily equal in size and value. Instead, they may be consistent or inconsistent depending on the specific measurements of the study population. Drop values in Table 4.11 almost double in comparison to the standardised sizing system by Aldrich (2008) shown in Table 4.12. Marked differences between waist and hip circumferences of Black women were established in the new sizing system. The ten measurement variables were selected based on the assertion by Faust and Carrier (2014:108) that when creating a garment that fits the body well, apparel experts recommend that, size development should be designed according to the specific part of the body. These measurements for size development were obtained from the 3D body scanner. The scanner measured the waist at its narrowest part and the hip measurement at its widest part.

**Figure 4.10 Jeans sample (100% cotton denim, non-stretch)**

Source: self-generated

Note the drop value in Table 4.12 (Aldrich-British sizing system) remains consistent from sizes 6 to size 20, while the drop value in Table 4.11 (which is the new jeans sizing system) is inconsistent because of the marked difference between waist and hip. Measurements from the new jeans sizing system in Table 4.11 has been used to construct a jeans sample shown in Figure 4.10. Note that there is no gape at the back waist, there is no pull across the front belly area, and the jeans fits the pear-shaped figure perfectly. The buttock shape is lifted to make the overall fit of the jeans on the wearer, to appear more appealing.

**Table 4.12 Aldrich measurement chart**

| **Size code** | **6** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** |
|---|---|---|---|---|---|---|---|---|---|---|
| Aldrich waist full | 60 | 64 | 68 | 72 | 76 | 80 | 84 | 88 | 94 | 100 |
| Aldrich hip full | 84 | 88 | 92 | 96 | 100 | 104 | 108 | 112 | 117 | 122 |
| **Aldrich Difference (Drop value waist and hip)** | **24** | **24** | **24** | **24** | **24** | **24** | **24** | **24** | **23** | **22** |

Source: Aldrich (2008:13)

The standardised chart in Table 4.12 by Aldrich (2008:13) reflects a figure with increased measurements for the waist and hips, in larger sizes. The European size chart was adopted by South Africans and is still used by South African universities for block creation and pattern making. Retailers and manufacturers have also adopted the size chart and adjusted measurements to suit their own customers. Aldrich (2008) calculated a difference of waist to hip at 24 cm for women in the United Kingdom. This shows a marked difference in the average measurements for women in the United Kingdom in comparison to the results obtained from the scanned average measurements of young Black South African pear-shaped women. In Table 4.12, Aldrich (2008:13) based the measurements on 4cm increments (from sizes 6-18) and 6cm increments (from sizes 20-24) between the size codes and is compliant with the body measurement size chart given in the European standard sizing system.

There are many factors that contribute to incorrect body measurements in the South African jeans market. Some are with regard to the taking of the key dimensions, or whether problems were related to land marking, and/or with a lack of consensus on the measurement (Strydom and De Klerk 2010:80). The differences in measurements between waist and hip do not suit a sizing chart of the extreme Black South African pear-shaped women's body.

### 4.5 Black South African pear-shaped size system vs standardised sizing

According to Aldrich (2008), a size 10 waist measurement is 68cm, and hip is 92cm and the drop value is 24cm. For a Black South African pear-shaped, a size 10 waist measurement is 70.5 and hip is 113cm with a drop value of 42.5cm. Millam (2014) suggests that considerations for the proposed sizing project should be the core size (exact measurement), not just an average of the body measurements. The waist and hip measurements were derived as a mean representation of a woman's bust size. However, in reality, most women who had children probably have a larger abdomen and hip. Therefore, research has to focus on a specific area, for example, a woman with children might have a bigger abdomen due to child bearing as compared to a woman without children who may have a flatter tummy. Most of the participants did

not have children.

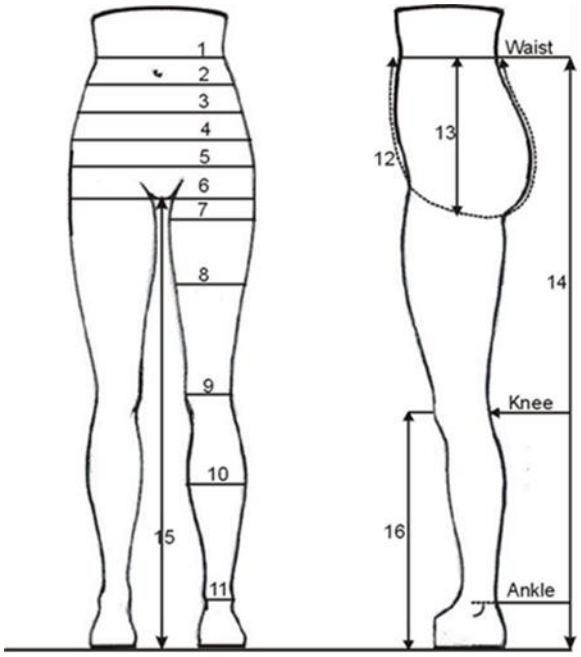
The size system in Table 4.13 has been taken from an established mannequin firm catering to the clothing industry in Cape Town and has been compared to a 20-year-old Black South African pear-shaped indigenous student from the Durban University of Technology. The measurements have been taken manually with a tape measure in order to see the difference in measurements from an average pear-shaped Black female represented by the mannequin and an extreme pear-shaped Black female. The students' curvier body measurement is represented in the last column of Table 4.13. It is noted that the drop value of the waist and hip of the student is 45cm, which is a big difference. Similarly, more than 60% of participants had a drop value of 35 and 46 cm. It is deduced that most Black women are curvier.

Table 4.13 Figure Forms measurement specification sheet

| | **AREA OF MEASUREMENT** | **910FF-P (Mannequin) Measurement** | **Black female body measurement** |
|---|---|---|---|
| | Based on total body height | 164 | 161 |
| 1 | WAIST | 71 | 75 |
| 3 | HIGH HIP (at 9cm below Waist) | 88.5 | 93.5 |
| 5 | HIP (at 20cm below Waist) | 100.5 | 118 |
| 6 | HIP (at 25 cm below Waist) | 102 | 120 |
| 7 | THIGH (top at Widest) | 60 | 68 |
| 9 | KNEE | 34 | 42 |
| 10 | CALF | 36 | 36.5 |
| 11 | ANKLE | 24 | 42 |
| 12 | THRU-RISE | 75 | 76 |
| 13 | BODY RISE | 26 | 26 |
| 14 | OUTSIDE LEG TO FLOOR | 104 | 110 |
| 15 | IN LEG TO FLOOR | 78 | 80 |
| 16 | KNEE HEIGHT (From Floor) | 43 | 47 |
| | Drop value | (31cm difference) | (45 cm difference) |

Note the smaller waist measurement of the Black female students in comparison to that of the mannequin, while all the other measurements are greater than the measurements of the mannequin. Especially larger are the hip and thigh measurements.

Figure 4.11 A measurement guide used for Table 4.13




Source: Figure Forms

The above is a 910FF-P mannequin measurement guide for Figure 4.11.

## 4.6 Concluding summary

The study was conducted as a cross-sectional investigation, which followed a three stage process. 60 Participants were selected for scanning. A tape measure was used to obtain hip and waist measurements as criteria for inclusion in the study. Those participants whose measurements were below a drop value of 39cm between waist and hip, were eliminated in the development of a jeans sizing system. Scanned key body measurements of young Black South African pear-shaped indigenous women were utilised to develop the new sizing system which was compared with the currently used size charts. Questionnaires were analysed based on the respondents' experiences with jeans sizing and fit.

The final chapter presents the conclusions of the study and makes recommendations for future research.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Introduction

The purpose of the study was to develop a jeans sizing system for South African indigenous Black women with pear-shaped body types. As a point of departure for the study, an anthropometric research process (see Figure 1.1) was followed, which focused on three phases to develop a new sizing system, namely:

- Procedures implemented for selecting pear-shaped Black women;
- Utilising the 3D body scanning technology to obtain accurate measurements; and
- Making up a jeans sample to test fit.

A procedural plan was developed in order to assist in the selection of appropriate methods, to cover all relevant aspects of the study.

The biographic information from the questionnaire was used to describe the demographics of the sample in terms of participants' age and the number of pregnancies a participant has had (Appendix 3) in order to establish if any of these factors affected body changes and impacted negatively on jeans fit. Knowing the participants' home province was investigated to establish whether Black female pear-shaped figures were consistent across geographical locations.

## 5.2 Conclusion

The current situation in South Africa regarding the supply of well-fitting jeans for the pear-shaped figure is challenging for both the clothing industry and the consumer. The objective of the study was to obtain a comprehensive list of lower body measurements for the pear-shaped figure, required for developing of a new jeans sizing system, utilising a 3D body scanner. The bust and the under bust measurements were included in the study as these are key measurements that

define a pear-shaped body. The pear-shaped body is characterised as a silhouette in which the hipline area and upper thigh region are much fuller than that of the hourglass silhouette, while the upper torso/bust area is smaller than the hourglass silhouette with narrow shoulders (Armstrong 1995).

A quantitative research approach, using a short questionnaire, 3D body scanning technology and a statistical analysis procedure, were used to collect and analyse the data. The results of the study were discussed and interpreted in accordance with the objectives stated in Chapter 1. The key finding of the study, which is the jeans sizing system for the South African pear-shaped body, is presented in Table 5.1.

### 5.3 Summary of the study results

Table 5.1 Jeans sizing system

| Sizes | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **10** | **87.5** | **70** | **113** | **41** | **71** | **78** | **71** | **100.5** | **27** | **34** | **20** |
| **12** | **92** | **76** | **116** | **42** | **75** | **85** | **71** | **98** | **28** | **34** | **20** |
| **14** | **98** | **79** | **121** | **43** | **78** | **87** | **73** | **102** | **33** | **34** | **20** |
| **16** | **105** | **84** | **125** | **43** | **83** | **88** | **69** | **100** | **35** | **34** | **21** |
| **18** | **109** | **91** | **133** | **45** | **91** | **92** | **72** | **99** | **38** | **34** | **22** |

Source: Generated from scanned measurements

Having acknowledged the gap in scientifically valid evidence that supports problems with jeans fit in general, this study revealed that the pear-shaped body of Black women, encounters most problematic with jeans fit. The most critical area within this body type is the marked difference between the waist and hip measurement. It has resulted in fit problems in the South African jeans manufacturing industry due to sizing systems that were adapted from European body measurements (Muthambi, De Klerk and Mastamet-Mason 2015:70). Comparisons were made between the currently used and the new jeans sizing system formulated in this study. The results of the study conclude that South African pear-shaped women have a very small waist with much larger hip measurements, which explains the need for jeans that fit

correctly at the hip without gaping and dropping at the back waist. The majority of the sample population scanned for measurements was from sizes 10-18, according to the European sizing system.

The development of a sizing system was followed by constructing a size 12 block pattern of a jeans prototype. The overall conclusion that can be drawn with regard to block patterns is that they need to be revised and adjusted according to current and accurate measurements of the pear-shaped body.

Although most South African manufacturers and retailers create their own block patterns according to body measurements specified by retailers, they still cannot achieve a perfect jeans fit. A company interviewed in Cape Town mentioned that jeans blocks can be adjusted continuously by technologists and designers when conducting random fit trials to improve jeans fit. A research scientist in garment technology is needed to investigate sizing systems pertaining to jeans fit.

It was necessary to describe and present the adapted British sizing systems currently used in South Africa by retailers and manufacturers as explained in Chapter 4 (Measurement Tables 4.12 by Aldrich and 4.13 by Figure Forms) in order to compare the measurements with the newly established sizing system. This study concludes that the manufacture of well-fitting jeans for the pear-shaped consumer, which makes up a large part of the South African population, is a challenge for the clothing industry.

### 5.4 Implications

The study's findings provided valuable information regarding the implications of drop values as these measurements identify the critical difference between the waist circumference and the hip circumference. The drop values assist in differentiating a western pear-shaped body from a South African pear-shaped body. The size 12 block pattern for this study was constructed according to the scanned measurements obtained from the 3D body scanner, to create an improved jeans fit.

This study addressed some of the flaws in current jeans sizing specifically related to waist and hip measurement drop values within the targeted group (pear-shaped South African Black women). Based on the results of the study, the conclusion can be made that customizing a sizing system for this consumer group is possible. The new sizing system presented in this study cannot be generalised to a larger population due to the small sample size who volunteered their participation in the study. Instead, it could serve as a base for further research in developing a jeans sizing system for the pear-shaped women, which can be useful to the clothing industry.

### 5.5 Challenges

The sizing system used by the South African clothing industry is not based on current relevant research. The effectiveness of an anthropometric study depends completely on body measurement data, which can be used for solving fit problems. In this study, success of data collection depended on participants who were extremely pear-shaped, resembling a Saartjie Baartman type of a body shape. There is a possibility that data collected may be skewed due to a relatively small sample size. Challenges that contributed to not obtaining a larger sample size were:

- The 3D body scanner that was used during the time of obtaining data for the study, was said to be the only scanner in the country and the researcher was given a specific time period to work on the scanner.

- The time allocated for use of the scanner was during the examination period and student recruitment for 3D body scanning proved to be problematic, as students were busy preparing for examination.

From this study it was found that the leg inseam measurement for a size16 was smaller than that of sizes 10, 12 and 14 (see Table 5.1). This inconsistency may have resulted due to the relatively small population (see Table 4.7).

## 5.6 Recommendations for the industry

The project recommends stakeholder engagement and participation especially if it is to statistically represent the population of pear-shaped Black women in the country. Stakeholders could assist with funding the project to run it successfully. A high level of expenditure in terms of research assistance was desirable for this study. Sponsor support could have contributed in purchasing scanning garments for each participant (to keep) and providing incentives for participation. This would more than likely, have encouraged additional recruitment of participants, resulting in a larger sample.

The results of the study revealed that there is a need for a better understanding of jeans sizing and fit for pear-shaped indigenous Black women in South Africa. The following recommendations are offered to the clothing industry and major stakeholders:

- South African jeans retailers and manufacturers should focus on specific body types and develop a jeans sizing system for different body types, depending on their market.

- Retailers should engage in jeans sizing and fit research in order to standardise sizing systems, so as to avoid confusion when consumers select sizes from different retailers.

- Stakeholders should form a joint partnership with the Department of Trade and Industry to fund an anthropometric survey in South Africa, using a 3D body scanner to scan participants for measurements. If this can be done, fit problems in general might be reduced in the country. This will result in bigger profit margins for manufacturers and retailers.

## 5.7 Recommendations for future study

It is recommended that a comprehensive anthropometric study of a better represented population of the South African pear-shaped Black women be conducted. Consequently, the findings can be generalised to a larger population.

It is recommended that a study be undertaken by academics in collaboration with the industry, in order to obtain current data by means of 3D body scanning technology, to update the outdated sizing systems.

From the scholarly literature and the researcher's own experience, it is clear that this kind of study is time consuming and will require substantial funding and months to update sizing systems. The findings indicate that the currently used sizing systems are not representative of the current Black pear-shaped womens' measurements. A sizing system was developed from data collected and it was possible to construct a well-fitting jeans sample from the measurements extracted (Figure 4.10).

### 5.8 General conclusions and contribution to knowledge

The results of this study serve as a basis for future development of jeans sizing systems for the young Black South African pear-shaped figure. The most important finding was the waist to hip drop value that revealed a need to follow up with a more extensive survey, to cater to this consumer group.

The following conclusions can be drawn. The hip circumference measurement of the participants was much larger than those used by the industry and the waist measurements of the participants were much smaller. Because body measurements of participants were varied, they were clustered according to similar measurements, to formulate the sizing system for the study.

It was concluded that the South African sizing systems being used in the clothing industry are based on the European body shape and adapted to suit South African Black indigenous women. Therefore, garment sizing needs to be urgently updated to meet the needs of this consumer market.

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# Appendix 1: Ethics form

DURBAN UNIVERSITY of TECHNOLOGY

**ETHICS STATEMENT:** Please complete and sign the attached Ethics Questionnaire.

All students who intend to complete research projects under the auspices of Durban University of Technology are required to complete this form. This is an abridged version of DUT's ethics questionnaire, adapted for students conducting research in the Faculty of Arts and Design.

Use the Durban University of Technology's Research Ethics Policy and Guidelines to ensure that ethical issues have been identified and addressed in the most appropriate manner, before finalizing and submitting your research proposal.

Please indicate [by an X as appropriate] which of the following ethical issues could impact on your research. Please type the motivations/further explanations where required in the cell headed COMMENTS. Copying and pasting the appropriate sections from your proposal may not suffice - please ensure that your justification/comments are addressed fully, as issues that inadequately answered will be returned to the student for further comment.

| No | Question | | |
|---|---|---|---|
| 1. | **DECEPTION** | | |
| | Is deception of any kind to be used? If so provide a motivation for acceptability. | No | x |
| | Comment: | Yes | |
| 2. | **CONFIDENTIALITY** | | |
| | Does the data collection process involve access to confidential personal/organizational data (including access to data for purposes other than this particular research project) without prior consent of the subjects? | No | x |
| | | Yes | |
| | Comment: | | |
| 3. | Will the data be collected and disseminated in a manner that will ensure confidentiality of the data and the identity of the participants? Please explain | No | |
| | | Yes | x |
| | | N/a | |
| | Comment: Participants will be afforded anonymity and confidentiality and their real names will not be used in the study. | | |
| 4. | Will the data obtained be stored and ultimately disposed of in a manner that will ensure the confidentiality of the participants? If "No" please explain. If "yes" how long will the confidential data be retained after the study (and by whom) and how will it be disposed of at the end of the period? | No | |
| | | Yes | x |
| | | N/a | |
| | Comment: Data will be saved on a flash disk and will be kept in a locked cupboard accessed by the researcher only. After completion and assessment of the dissertation, the raw data on the disk (and any printouts) will be destroyed. | | |
| 5. | Will the research involve access to data banks that are subject to privacy legislation? If yes, specify and explain. | No | x |
| | | Yes | |
| | Comment: | | |

| | | | |
|---|---|---|---|
| | **RECRUITMENT** | | |
| 6. | Does respondent recruitment involve any direct personal approach from the researchers to the potential subjects? Refer to the sampling plan in your proposal and copy the relevant sections here.<br>Comment: Posters at the Cape Peninsula University of Technology was used mainly as a way of marketing and inviting participants in the anthropometric study. Pre-selection of participants will be conducted on a weekend at CPUT-Bellville Campus. The researcher will obtain permission from the head of department to utilize the venue. Those candidates selected to participate in the study will be requested to fill in the questionnaire. The researcher will lay out questionnaires on the tables and a pencil next to each questionnaire. The researcher will obtain permission from the University residences and HOD's before placing placards. | No<br>Yes | x<br> |
| 7. | Are participants linked to the researcher in a particular relationship i.e. employees, colleagues, family, students? If yes specify how.<br>Comment: | No<br>Yes | x<br> |
| 8. | If yes to 7, is there any pressure from researchers or others that might influence the potential subjects to enroll? Elaborate.<br>Comment: n/a | No<br>Yes | <br> |
| 9. | Does recruitment involve the circulation/publication of an advertisement, circular, letter etc? Specify.<br>Comment: There will be placards in universities inviting participants in the study. | Yes<br>No | x<br> |
| 10 | Will subjects receive any financial or other benefits as a result of participation? If yes, explain the nature of the reward, and safeguards.<br>Comment: | Yes<br>No | <br>x |
| 11 | Is the research targeting any particular ethnic or community group? If yes, motivate why it is necessary/acceptable. If you have not consulted a representative of this group, give a reason. In addition explain any consultative processes, identifying participants. Should consultation not take place, give a motivation.<br>Comment: The nature of the research involves jeans' fit for a specific ethnic group, Black women. Participation will be on a voluntary basis. The group is broad, and, as volunteers are invited, it would be impossible to consult in advance, or to identify a "representative". | Yes<br>No | x<br> |
| 12 | Does the research fulfill the criteria for informed consent? [See guidelines]. If yes, no further answer is needed. If no, please specify how and why.<br>Comment: Participants will sign informed consent at CPUT. | Yes<br>No | x<br> |
| 13 | Does consent need to be obtained from special and vulnerable groups (see guidelines). If yes, describe the nature of the group and the procedures used to obtain permission.<br>Comment: | Yes<br>No | <br>x |
| 14 | Will a Subject Information Letter be provided and written consent be obtained? If no, explain. If yes, attach copies to proposal. In the case of subjects who are not familiar with English (e.g. it is a second language), explain what arrangements will be made to ensure comprehension of the Subject Information Letter, Informed Consent Form and other questionnaires/documents.<br>Comment: The researcher will explain the contents of information letter to partcipants. | Yes<br>No | x<br> |
| | Will results of the study be made available to those interested? If no, explain why. | Yes | x |

| | | | |
|---|---|---|---|
| 15 | If yes, explain how.<br>Comment: The Thesis will be available to read in any DUT campus library. | No | |
| 16 | **RISKS TO SUBJECTS**<br>Will participants be asked to perform any acts or make statements, which might be expected to cause discomfort, compromise them, diminish self-esteem or cause them to experience embarrassment or regret? If yes, explain.<br>Comment: To ensure that participants do not feel any discomfort, each participant will receive a clean scanning garment in which the participant has to be dressed in for scanning purposes. Arrangements will be made for participants to change into scanning garments in a private room. Each participant will enter the scanner cubicle individually. The researcher will be present at all times to ensure that any signs of discomfort are identified and that any problem is dealt with immediately. | Yes<br>No | x |
| 17 | Might any aspect of your study reasonably be expected to place the participant at risk of criminal or civil liability? If yes, explain.<br>Comment: | Yes<br>No | <br>x |
| 18 | Might any aspect of your study reasonably be expected to place the participant at risk of damage to their financial standing or social standing or employability? If yes, explain.<br>Comment: | Yes<br>No | <br>x |
| 19 | Does the research involve any questions, stimuli, tasks, investigations or procedures which may be experienced by participants as stressful, anxiety producing, noxious, aversive or unpleasant during or after the research procedures? If yes, explain.<br>Comment: | Yes<br>No | <br>x |
| 20 | BENEFITS<br>Is this research expected to benefit the subjects directly or indirectly? Explain any such benefits.<br>Comment: The jeans sizing system will not benefit the subjects directly: it is intended to assist only in generally creating a better fitting jean for a more curved indigenous Black figure. South African retailers and clothing manufacturers will benefit from utilizing the specification charts. | Yes<br>No | <br>x |
| 21 | Does the researcher expect to obtain any direct or indirect financial or other benefits from conducting the research? If yes, explain.<br>Comment: | Yes<br>No | <br>x |
| 22 | **SPONSORS: INTERESTS AND INDEMNITY**<br>Will this research be undertaken on the behalf of or at the request of a company, or other commercial entity or any other sponsor? If yes, identify the entity.<br>Comment: | Yes<br>No | <br>x |
| 23 | If yes to 22, will that entity undertake in writing to abide by Durban University of Technology's Research Committees Research Ethics Policy and Guidelines? If yes, do not explain further. If no, explain<br>Comment: n/a | Yes<br>No | |
| 24 | If yes to 23, will that entity undertake in writing to indemnify the institution and the researchers? If yes, do not explain further. If no, explain.<br>Comment: n/a | Yes<br>No | |

| | | | |
|---|---|---|---|
| 25 | Does the researcher have indemnity cover relating to research activities? If yes, specify. If no, explain why not.<br>Comment: DUT insurance applies to DUT researchers. | Yes | x |
| | | No | |
| 26 | Does the researcher have any affiliation with, or financial involvement in, any organization or entity with direct or indirect interests in the subject matter or materials of this research? If yes, specify<br>Comment: | Yes | |
| | | No | x |

The undersigned declares that the above questions have been answered truthfully and accurately

STUDENT NAME: .....Phumza Ntombovuyo Sokhetye.....

SIGNATURE: [redacted].....

DATE: 26/09/2014

Appendix 2a: Letter to CPUT

Durban University of Technology

Department of Clothing and Textile Studies

Steve Biko Campus

12 March 2014

**To:** Head of Department

Dr E. Hovgaard

Cape Peninsula University of Technology

Department of Clothing and Textile Technology

**Cc:** Technology Station Manager

Mr S. Isaacs

Department of Clothing and Textile Technology

I am a lecturer at the Durban University of Technology studying for my MTech degree in Fashion in the department of Fashion and Textiles. My research study involves the use of a 3D body scanner.

My supervisor is Professor Winnie Yu from the Hong Kong Polytechnic University and my co-supervisor is Ms Farida Kadwa from the Durban University of Technology's department of Fashion and Textiles.

I am planning to utilise the body scanner from 1May to 30 June 2014 (2 months) as discussed telephonically. Lucille Heugh has agreed telephonically to give me some basic training on how to utilise the body scanner and extract data, to enable me to operate the scanner. She will be paid a fixed rate agreed upon. I am requesting two of your BTech students for assistance in recruiting participants for the study. The two students will be paid a fixed rate agreed upon.

Sincerely

Phumza Zigana

## Appendix 2b: Letter to CPUT

DUT
DURBAN
UNIVERSITY OF
TECHNOLOGY

12 March 2014

Dr Hovgaard
Department of Clothing and Textile Technology
Cape Peninsula University of Technology

RE: Phumza Sokhetye

Dear Dr Hovgaard

Phumza Sokhetye (Student number: 16202820) is registered for an M Tech degree in Fashion at DUT. The title of her study is: **A jeans' sizing system for indigenous Black women in Cape Town.**

Phumza plans to utilize the body scanner at CPUT from 1 May to 30 June 2014, to obtain measurements of Black females in Cape Town. Her intention is develop a jeans sizing system for indigenous Black women who experience difficulty in obtaining well-fitting jeans.

Your assistance in the above matter will be appreciated.

Sincerely

[redacted]....

Farida Kadwa
Senior Lecturer: Dept. of Fashion and Textiles
Durban University of Technology
Brickfield Campus
+27 31 373 3735
+27 83 656 9886

# Appendix 3: Questionnaire

**Research Title: Development of a jeans sizing system for young Black South African women**

**Instructions**
Only one choice is required for each question unless otherwise specified.

## QUESTION 1: BIOGRAPHIC INFORMATION

| 1.1 | 1.2 | 1.3 | 1.4 |
|---|---|---|---|
| **Respondent's Name** | **Age in last birthday (years)** | **Number of pregnancies**<br><br>1=Zero<br>2=1-2<br>3=3-4<br>4=≥5 | **Home Province**<br>1=KZN<br>2=Limpopo<br>3=Mpumalanga<br>4= Gauteng<br>5=Free State<br>6=Western Cape<br>7=Eastern Cape<br>8=Northern Cape<br>9=North West |
| | | | |

## QUESTION 2: JEANS FIT

2.1 What fitting problems do you encounter around your waistline, when trying on jeans?

| Nature of the fitting problem | Never 0% | Seldom 1-25% | Sometimes 26-50% | Most of the time 51-75% | Always 76-100% |
|---|---|---|---|---|---|
| 2.1.1 Gaping at the back | | | | | |
| 2.1.2 Tight fitting | | | | | |

2.2 Have you ever struggled to find a jean that fits you well?

| Yes | No |
|---|---|

2.3 Do you spend too much time trying on jeans before you purchase?

| Yes | No |
|---|---|

## Appendix 4: Letter from IREC

DURBAN UNIVERSITY of TECHNOLOGY

Institutional Research Ethics Committee
Durban University of Technology
P O Box 1334
Durban
4000

10 April 2012

Ms P N Sokhetye
45 Watsonia, Aloe Terrace
Westwood Estate
Westville
3629

Dear Ms Sokhetye

**ACKNOWLEDGEMENT OF RECEIPT OF APPLICATION FOR ETHICAL APPROVAL**

**Title:** A jeans' sizing system for indigenous Black women in South Africa
**Reference Number: REC 28/12**

The Institutional Research Ethics Committee wish to acknowledge receipt of your research proposal, received on 30 March 2012 which is to be reviewed at an IREC meeting scheduled for 23 April 2012.

A reference number has been assigned to your proposal. You are required to quote this number for all queries relating to the study.

Yours Sincerely

[redacted]

Dr D Naude
Chair: IREC

## Appendix 5: Information letter

DURBAN UNIVERSITY of TECHNOLOGY

**INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)**
**LETTER OF INFORMATION AND CONSENT**

**Title of the Research Study:** Development of a jeans sizing system for young Black South African women

**Principle Investigator/s/researcher:** Phumza Ntombovuyo Sokhetye

**Supervisor:** Prof. Winnie Yu

**Co-supervisor:** Mrs. Farida Kadwa

**Brief Introduction and Purpose of the Study:**

According to my assumption, jeans are typically not designed for Black women, and there are various issues that Black women face when looking to purchase a pair of well-fitting jeans. Most jeans available in retail outlets have a slight difference in measurement between the hip and waist. This is problematic for indigenous Black females as there is often a marked difference between the hip and waist; as black women generally have a narrow waist with a wider hip.

The purpose of the study is to develop a better jeans' fit for Black women consumers.

**Outline of the Procedures**

If you are happy to assist with the study please sign the letter and return to me. Those of you, who fit the criteria for scanning, will be required to fill in a questionnaire to provide information on your experience as customers when purchasing jeans. I will use a traditional tape measure, measuring each of you around the waist and hip circumference with clothes on.

**Risks or Discomforts to the Subject:**

There are no risks in taking manual body measurements.

**Benefits:**

A jeans' sizing system that will represent the majority of triangular Black women is anticipated.

**Reason/s why the Subject May Be Withdrawn from the Study:**

If you wish to withdraw from the study, you may do so immediately.
If you show any uneasiness or hesitation, it will be suggested that you withdraw from the scanning procedure.

**Remuneration:**

Participation is voluntary and there will be no remuneration for the subject.

**Costs of the Study:**

You are not expected to contribute to any costs of the study.

**Confidentiality:**

You will be afforded anonymity and confidentiality and your name will not be used in the study.

**Research-related Injury:**

There are no risks or injuries.

**Persons to Contact in the Event of Any Problems or Queries:**

In the event of any problems or queries please contact the researcher, Phumza Sokhetye at 031 373 2614 or 076 574 0661; my co-supervisor Farida Kadwa, on 031 373 3735; or the Institutional Research Ethics administrator, on 031 373 2900.

**Statement of Agreement to Participate in the Research Study:**

(I,..... subject's full name ID number....., have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by .....to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study.

Subject's name (print) .....

Subject's signature:..... Date:.....

Researcher's name (print) signature: .....

Researcher's signature:.....Date:.....

Witness name (print) signature: .....

Witness signature: .....Date:.....

Appendix 6: Poster

# Jeans for Africa

**Have you ever found that you cannot find a good jeans' fit because they're all designed for overseas customer whose body shape may differ significantly from those in African women?**

**Assist me with my research into a Jeans' sizing system which will suit African women!**

## 1st Phase data collection

**Venue:** Sacco Residence (CPUT Bellville campus)

**Date:** 5-11 May 2014

**Time:** 16h30-19h30

## 2nd Phase data collection

**Venue:** 3D body scan venue
Clothing & Textile Department
(CPUT Bellville campus)

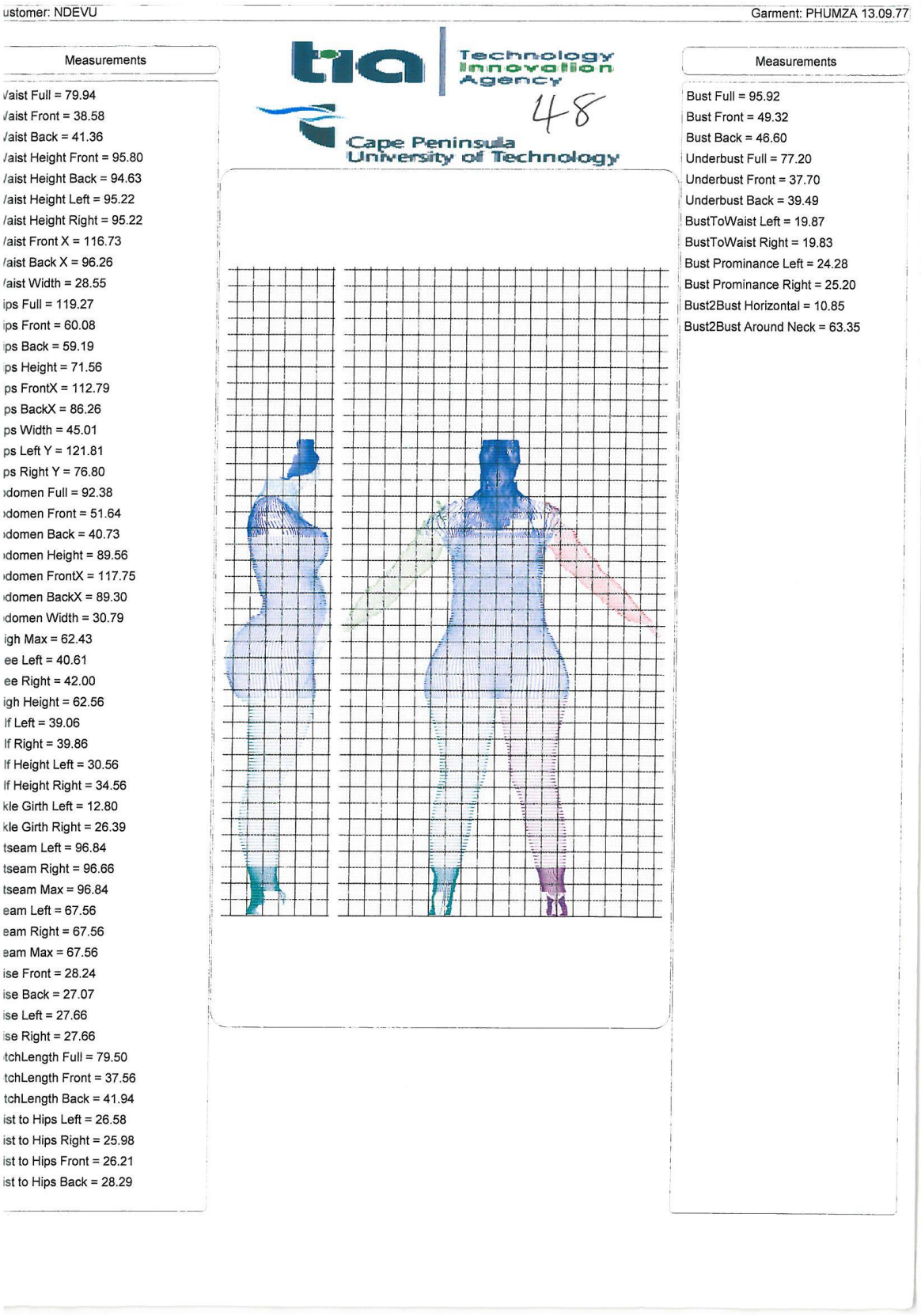
**Date:** 5 May to 30 June 2014

**Time:** 9am - 4pm Monday to Friday

**For more information contact Phumza @ 076 574 0661**

**"If you have a smaller waist than hips, we need you!"**

Appendix 7: 3D body image



## Appendix 8: Body measurements (raw data)

| | Body measurements sheet in centimetres (n=60) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | Bust | Waist full | Hips full | Knee | Under bust | Crotch full | In seam | Out seam | Body rise | Crotch to knee | Waist to hip | Drop-waist & hip |
| 161 | 85 | 71 | 113 | 42 | 71 | 82 | 72 | 102 | 28 | 33.7 | 20 | 42 |
| 167 | 85 | 68 | 107 | 41 | 68 | 74 | 83 | 106 | 27 | 33.9 | 19.7 | 39 |
| 161 | 87 | 76 | 116 | 42 | 70 | 79 | 70 | 97 | 28 | 33.5 | 21.1 | 40 |
| 160 | 99 | 86 | 126 | 44 | 80 | 88 | 69 | 94 | 35 | 33.4 | 21.8 | 40 |
| 173 | 88 | 79 | 121 | 43 | 77 | 89 | 80 | 109 | 28.9 | 35.5 | 20.3 | 42 |
| 150 | 90 | 70 | 114 | 42 | 68 | 78 | 64 | 94 | 28 | 32 | 20 | 44 |
| 150 | 85 | 73 | 117 | 42 | 68 | 82 | 65 | 95 | 28 | 33.1 | 20 | 44 |
| 161 | 83 | 60 | 95 | 42 | 62 | 68 | 76 | 106 | 27.7 | 34 | 19.7 | 35 |
| 167 | 92 | 74 | 116 | 42 | 71 | 75 | 72 | 99 | 28 | 34 | 20 | 42 |
| 158 | 89 | 70 | 110 | 40 | 69 | 76 | 71 | 97 | 28 | 33.7 | 20 | 40 |
| 159 | 87 | 69 | 110 | 41 | 75 | 76 | 76 | 101 | 27 | 34 | 20 | 41 |
| 155 | 109 | 91 | 130 | 44 | 91 | 88 | 65 | 97 | 35.8 | 33,2 | 21.7 | 40 |
| 152 | 91 | 71 | 113 | 41 | 77 | 81 | 67 | 98 | 27 | 33 | 20 | 42 |
| 158 | 90 | 71 | 114 | 41 | 73 | 82 | 69 | 96 | 27 | 34 | 20 | 43 |
| 158 | 93 | 73 | 113 | 41 | 72 | 78 | 76 | 100 | 27 | 34 | 20 | 40 |
| 158 | 88 | 69 | 110 | 40 | 72 | 76 | 67 | 98 | 26.5 | 34 | 20 | 41 |
| 153 | 102 | 89 | 132 | 45 | 83 | 92 | 75 | 100 | 36.8 | 34 | 22.7 | 43 |
| 158 | 93 | 80 | 119 | 43 | 76 | 82 | 69 | 96 | 32 | 34 | 21.9 | 39 |
| 162 | 99 | 80 | 121 | 43 | 82 | 89 | 76 | 102 | 33 | 34.7 | 20.8 | 41 |
| 165 | 93 | 75 | 119 | 43 | 76 | 87 | 69 | 98 | 32.5 | 34.2 | 20 | 44 |
| 161 | 89 | 70 | 108 | 42 | 71 | 77 | 73 | 96 | 25.6 | 34 | 20 | 38 |
| 160 | 87 | 68 | 113 | 42 | 71 | 78 | 70 | 102 | 27 | 34.3 | 20 | 45 |
| 167 | 90 | 74 | 116 | 44 | 74 | 86 | 73 | 104 | 28 | 34.6 | 20 | 42 |
| 162 | 99 | 82 | 117 | 42 | 81 | 85 | 68 | 100 | 29.7 | 34 | 20 | 35 |
| 158 | 93 | 76 | 117 | 42 | 75 | 85 | 71 | 97 | 28 | 34 | 20 | 41 |
| 156 | 81 | 68 | 104 | 39 | 69 | 75 | 63 | 89 | 26 | 34,3 | 19.7 | 36 |
| 153 | 103 | 90 | 133 | 45 | 91 | 90 | 67 | 98 | 36.5 | 33.9 | 22 | 39 |
| 167 | 89 | 67 | 107 | 42 | 69 | 75 | 84 | 107 | 26.7 | 34.6 | 19.7 | 40 |
| 162 | 97 | 76 | 113 | 43 | 76 | 85 | 76 | 102 | 27 | 34 | 20 | 41 |
| 168 | 98 | 81 | 121 | 43 | 78 | 89 | 78 | 106 | 28 | 34 | 20 | 40 |
| 169 | 87 | 72 | 114 | 41 | 71 | 86 | 79 | 108 | 28 | 34.9 | 20 | 42 |
| 161 | 88 | 68 | 103 | 42 | 68 | 75 | 69 | 97 | 25 | 34 | 19.7 | 35 |
| 159 | 99 | 78 | 120 | 43 | 78 | 87 | 72 | 97 | 33 | 34 | 20.5 | 40 |
| 161 | 98 | 78 | 120 | 42 | 81 | 87 | 73 | 102 | 33.5 | 34 | 20.7 | 42 |
| 161 | 98 | 80 | 121 | 43 | 77 | 87 | 69 | 97 | 33.5 | 34 | 20.8 | 41 |
| 166 | 86 | 68 | 111 | 41 | 68 | 76 | 76 | 104 | 26 | 34.3 | 20 | 43 |
| 169 | 82 | 66 | 101 | 39 | 68 | 75 | 76 | 108 | 26 | 34.6 | 19.7 | 35 |
| 169 | 101 | 86 | 121 | 43 | 77 | 88 | 73 | 106 | 34 | 34.2 | 20.7 | 35 |
| 153 | 89 | 69 | 107 | 41 | 74 | 76 | 67 | 98 | 26 | 33.1 | 20 | 40 |
| 166 | 113 | 99 | 138 | 45 | 96 | 94 | 72 | 99 | 38 | 34.1 | 22.9 | 39 |
| 166 | 96 | 71 | 117 | 42 | 79 | 85 | 71 | 99 | 28.7 | 34 | 20 | 46 |
| 160 | 92 | 79 | 123 | 43 | 76 | 86 | 69 | 94 | 33.6 | 34 | 20.9 | 44 |
| 161 | 81 | 67 | 103 | 42 | 66 | 74 | 71 | 97 | 26.8 | 34 | 20 | 36 |
| 157 | 95 | 73 | 107 | 39 | 79 | 73 | 71 | 100 | 28 | 33.9 | 20 | 34 |
| 159 | 84 | 67 | 105 | 39 | 67 | 74 | 70 | 97 | 28 | 33.7 | 20 | 38 |
| 167 | 108 | 84 | 125 | 43 | 83 | 87 | 75 | 103 | 34.5 | 34.4 | 21.5 | 42 |
| 152 | 105 | 82 | 124 | 43 | 88 | 88 | 67 | 100 | 34.5 | 33.3 | 21.3 | 42 |
| 162 | 81 | 70 | 111 | 42 | 68 | 85 | 71 | 102 | 27 | 34 | 20 | 41 |
| 156 | 85 | 76 | 110 | 42 | 73 | 73 | 66 | 94 | 28 | 33.3 | 20 | 34 |
| 161 | 109 | 93 | 134 | 42 | 91 | 94 | 75 | 102 | 38.5 | 34 | 21.9 | 41 |
| 164 | 85 | 73 | 119 | 42 | 73 | 92 | 74 | 102 | 28 | 34 | 20 | 46 |
| 167 | 90 | 74 | 116 | 42 | 74 | 86 | 76 | 107 | 28 | 34.5 | 20 | 42 |
| 157 | 78 | 66 | 104 | 38 | 67 | 77 | 76 | 100 | 25.8 | 34 | 19.7 | 38 |
| 162 | 98 | 84 | 119 | 42 | 79 | 85 | 76 | 102 | 29 | 34 | 21.6 | 35 |
| 165 | 88 | 74 | 116 | 42 | 75 | 86 | 73 | 100 | 28 | 34.2 | 20 | 42 |
| 166 | 89 | 74 | 106 | 40 | 73 | 74 | 74 | 102 | 26 | 34.6 | 20 | 32 |
| 161 | 89 | 72 | 111 | 42 | 71 | 84 | 66 | 103 | 28 | 34 | 20 | 39 |
| 167 | 87 | 72 | 110 | 41 | 71 | 84 | 72 | 99 | 28 | 34.3 | 20 | 38 |
| 166 | 91 | 76 | 117 | 42 | 73 | 86 | 71 | 98 | 28 | 34.1 | 20 | 41 |
| 159 | 101 | 80 | 119 | 42 | 87 | 82 | 70 | 97 | 28 | 34 | 20 | 39 |

## Appendix 9.1: Frequencies variables Bust

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 85 | 5 | 8,3 | 8,3 | 8,3 |
| | 87 | 5 | 8,3 | 8,3 | 16,7 |
| | 99 | 7 | 11,7 | 11,7 | 28,3 |
| | 88 | 4 | 6,7 | 6,7 | 35,0 |
| | 90 | 4 | 6,7 | 6,7 | 41,7 |
| | 83 | 1 | 1,7 | 1,7 | 43,3 |
| | 92 | 2 | 3,3 | 3,3 | 46,7 |
| | 89 | 3 | 5,0 | 5,0 | 51,7 |
| | 109 | 1 | 1,7 | 1,7 | 53,3 |
| | 91 | 2 | 3,3 | 3,3 | 56,7 |
| | 93 | 3 | 5,0 | 5,0 | 61,7 |
| | 102 | 1 | 1,7 | 1,7 | 63,3 |
| | 93 | 1 | 1,7 | 1,7 | 65,0 |
| | 81 | 3 | 5,0 | 5,0 | 70,0 |
| | 103 | 1 | 1,7 | 1,7 | 71,7 |
| | 97 | 1 | 1,7 | 1,7 | 73,3 |
| | 98 | 4 | 6,7 | 6,7 | 80,0 |
| | 86 | 1 | 1,7 | 1,7 | 81,7 |
| | 82 | 1 | 1,7 | 1,7 | 83,3 |
| | 101 | 2 | 3,3 | 3,3 | 86,7 |
| | 113 | 1 | 1,7 | 1,7 | 88,3 |
| | 96 | 1 | 1,7 | 1,7 | 90,0 |
| | 95 | 1 | 1,7 | 1,7 | 91,7 |
| | 84 | 1 | 1,7 | 1,7 | 93,3 |
| | 108 | 1 | 1,7 | 1,7 | 95,0 |
| | 105 | 1 | 1,7 | 1,7 | 96,7 |
| | 109 | 1 | 1,7 | 1,7 | 98,3 |
| | 78 | 1 | 1,7 | 1,7 | 100,0 |
| | Total | 60 | 100,0 | 100,0 | |

## Appendix 9.2: Frequencies variables Waist Full

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 71 | 4 | 6,7 | 6,7 | 6,7 |
| | 68 | 4 | 6,7 | 6,7 | 13,3 |
| | 76 | 3 | 5,0 | 5,0 | 18,3 |
| | 86 | 2 | 3,3 | 3,3 | 21,7 |
| | 79 | 2 | 3,3 | 3,3 | 25,0 |
| | 70 | 4 | 6,7 | 6,7 | 31,7 |
| | 73 | 4 | 6,7 | 6,7 | 38,3 |
| | 60 | 1 | 1,7 | 1,7 | 40,0 |
| | 74 | 3 | 5,0 | 5,0 | 45,0 |
| | 69 | 3 | 5,0 | 5,0 | 50,0 |
| | 91 | 1 | 1,7 | 1,7 | 51,7 |
| | 89 | 1 | 1,7 | 1,7 | 53,3 |
| | 80 | 4 | 6,7 | 6,7 | 60,0 |
| | 75 | 1 | 1,7 | 1,7 | 61,7 |
| | 82 | 2 | 3,3 | 3,3 | 65,0 |
| | 68 | 1 | 1,7 | 1,7 | 66,7 |
| | 90 | 1 | 1,7 | 1,7 | 68,3 |
| | 67 | 3 | 5,0 | 5,0 | 73,3 |
| | 76 | 2 | 3,3 | 3,3 | 76,7 |
| | 81 | 1 | 1,7 | 1,7 | 78,3 |
| | 72 | 3 | 5,0 | 5,0 | 83,3 |
| | 78 | 2 | 3,3 | 3,3 | 86,7 |
| | 124 | 1 | 1,7 | 1,7 | 88,3 |
| | 99 | 1 | 1,7 | 1,7 | 90,0 |
| | 84 | 1 | 1,7 | 1,7 | 91,7 |
| | 93 | 1 | 1,7 | 1,7 | 93,3 |
| | 66 | 1 | 1,7 | 1,7 | 95,0 |
| | 84 | 1 | 1,7 | 1,7 | 96,7 |
| | 74 | 2 | 3,3 | 3,3 | 100,0 |
| | Total | 60 | 100,0 | 100,0 | |

## Appendix 9.3 Frequencies variables Hips Full

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 113 | 5 | 8,3 | 8,3 | 8,3 |
| | 107 | 4 | 6,7 | 6,7 | 15,0 |
| | 116 | 5 | 8,3 | 8,3 | 23,3 |
| | 126 | 1 | 1,7 | 1,7 | 25,0 |
| | 121 | 5 | 8,3 | 8,3 | 33,3 |
| | 114 | 3 | 5,0 | 5,0 | 38,3 |
| | 117 | 5 | 8,3 | 8,3 | 46,7 |
| | 95 | 1 | 1,7 | 1,7 | 48,3 |
| | 110 | 5 | 8,3 | 8,3 | 56,7 |
| | 132 | 2 | 3,3 | 3,3 | 60,0 |
| | 119 | 5 | 8,3 | 8,3 | 68,3 |
| | 108 | 1 | 1,7 | 1,7 | 70,0 |
| | 10 | 2 | 3,3 | 3,3 | 73,3 |
| | 133 | 1 | 1,7 | 1,7 | 75,0 |
| | 103 | 2 | 3,3 | 3,3 | 78,3 |
| | 120 | 2 | 3,3 | 3,3 | 81,7 |
| | 111 | 3 | 5,0 | 5,0 | 86,7 |
| | 101 | 1 | 1,7 | 1,7 | 88,3 |
| | 138 | 1 | 1,7 | 1,7 | 90,0 |
| | 123. | 1 | 1,7 | 1,7 | 91,7 |
| | 105 | 1 | 1,7 | 1,7 | 93,3 |
| | 125 | 1 | 1,7 | 1,7 | 95,0 |
| | 124 | 1 | 1,7 | 1,7 | 96,7 |
| | 134 | 1 | 1,7 | 1,7 | 98,3 |
| | 106 | 1 | 1,7 | 1,7 | 100,0 |
| | Total | 60 | 100,0 | 100,0 | |

## Appendix 9.4: Frequencies variables Inseam

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 72 | 5 | 8,3 | 8,3 | 8,3 |
| | 83 | 1 | 1,7 | 1,7 | 10,0 |
| | 70 | 4 | 6,7 | 6,7 | 16,7 |
| | 69 | 7 | 11,7 | 11,7 | 28,3 |
| | 80 | 1 | 1,7 | 1,7 | 30,0 |
| | 64 | 1 | 1,7 | 1,7 | 31,7 |
| | 65 | 2 | 3,3 | 3,3 | 35,0 |
| | 76 | 10 | 16,7 | 16,7 | 51,7 |
| | 71 | 7 | 11,7 | 11,7 | 63,3 |
| | 67 | 5 | 8,3 | 8,3 | 71,7 |
| | 75 | 3 | 5,0 | 5,0 | 76,7 |
| | 73 | 5 | 8,3 | 8,3 | 85,0 |
| | 68 | 1 | 1,7 | 1,7 | 86,7 |
| | 63 | 1 | 1,7 | 1,7 | 88,3 |
| | 84 | 1 | 1,7 | 1,7 | 90,0 |
| | 78 | 1 | 1,7 | 1,7 | 91,7 |
| | 79 | 1 | 1,7 | 1,7 | 93,3 |
| | 66 | 2 | 3,3 | 3,3 | 96,7 |
| | 74 | 2 | 3,3 | 3,3 | 100,0 |
| | Total | 60 | 100,0 | 100,0 | |

## Appendix 9.5: Frequencies variables Outseam

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 102 | 10 | 16,7 | 16,7 | 16,7 |
| | 106 | 4 | 6,7 | 6,7 | 23,3 |
| | 97 | 10 | 16,7 | 16,7 | 40,0 |
| | 94 | 4 | 6,7 | 6,7 | 46,7 |
| | 109 | 1 | 1,7 | 1,7 | 48,3 |
| | 95 | 1 | 1,7 | 1,7 | 50,0 |
| | 99 | 4 | 6,7 | 6,7 | 56,7 |
| | 101 | 1 | 1,7 | 1,7 | 58,3 |
| | 98 | 6 | 10,0 | 10,0 | 68,3 |
| | 96 | 3 | 5,0 | 5,0 | 73,3 |
| | 100 | 7 | 11,7 | 11,7 | 85,0 |
| | 104 | 2 | 3,3 | 3,3 | 88,3 |
| | 89 | 1 | 1,7 | 1,7 | 90,0 |
| | 107 | 2 | 3,3 | 3,3 | 93,3 |
| | 108 | 2 | 3,3 | 3,3 | 96,7 |
| | 103 | 2 | 3,3 | 3,3 | 100,0 |
| | Total | 60 | 100,0 | 100,0 | |